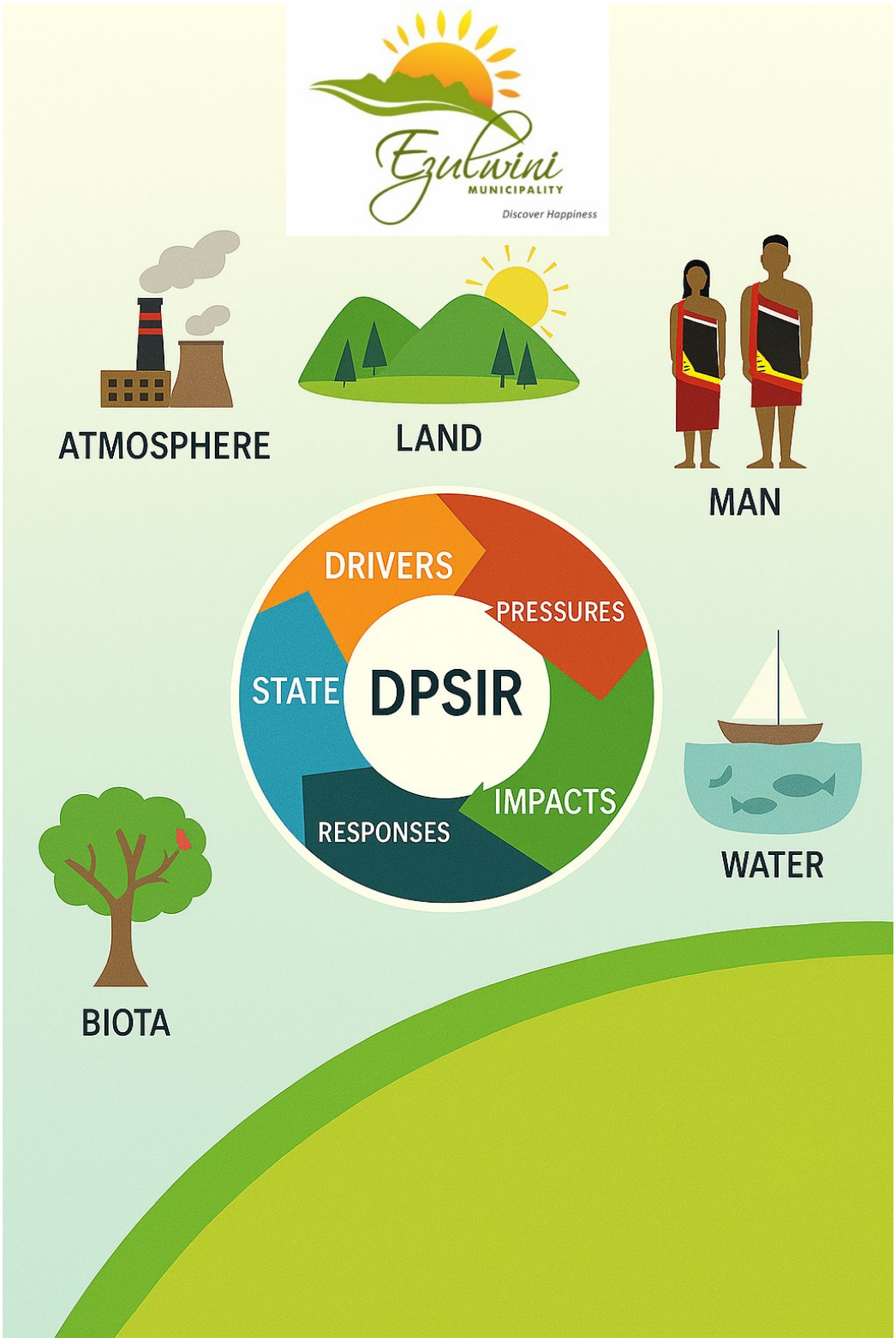

Ezulwini Municipality State of Environment Report

September 2025

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List of Acronyms

AfDB: African Development Bank
AGM: Annual General Meeting
ATDC: Agroecology Training and Demonstration Centre
CCD: Convention to Combat Desertification
CMP: Comprehensive Mobility Plan
COVID-19: Coronavirus Disease 2019
DPSIR: Drivers-Pressures-State-Impacts-Responses
DRR: Disaster Risk Reduction
E.: Eswatini Lilangeni (currency symbol)
EEA: Eswatini Environment Authority
EEC: Eswatini Electricity Company
EMA: Environment Management Act
ESD: Education for Sustainable Development
ESDG: Eswatini Sustainable Development Goals
EWR: Environmental Waste Regulations
EWSC: Eswatini Water Services Corporation
FISH: Five Star Hotel
GIS: Geographic Information System
GWh: Gigawatt hour
ICC: International Convention Centre
IDP: Integrated Development Plan
IAPs: Invasive Alien Plant Species
ISO: International Organization for Standardization
JICA: Japan International Cooperation Agency
LED: Light Emitting Diode
MRF: Materials Recovery Facility
MEPS: Minimum Energy Performance Standards
ML: Megalitre
MTEA: Ministry of Tourism and Environmental Affairs
NGO: Non-Governmental Organization
NTU: Nephelometric Turbidity Unit
PF: Public Facilities
PV: Photovoltaic
R1–R4: Residential zoning categories
ROSS: Regional Open Space System
SDG: Sustainable Development Goal
SEA: Strategic Environmental Assessment
SHEQ: Safety Health Environment and Quality
SNL: Swazi Nation Land
SOER: State of Environment Report
ToU: Time-of-Use (tariff)
TPS: Town Planning Scheme
UN: United Nations
UNDP: United Nations Development Programme
UNEP: United Nations Environment Programme
UNFCCC: United Nations Framework Convention on Climate Change
WHO: World Health Organization

Executive Summary

Ezulwini Municipality's State of Environment Report offers a detailed analysis of the town's environmental status, achievements, and ongoing challenges as it rapidly urbanizes in Eswatini's central corridor. The report, structured using the DPSIR (Drivers-Pressures-State-Impacts-Responses) framework, integrates local data, stakeholder input, and policy analysis to align municipal actions with national and international sustainability targets.

Key Findings by Chapter:

Introduction & Methodology: Ezulwini, strategically located between Mbabane and Manzini, has grown into a vibrant urban centre with a population of about 2,800. The report's methodology is based on the DPSIR framework, supported by custom indicators and robust data triangulation to ensure rigor and relevance.

Environmental Governance & Sustainability: The Municipality has made notable gains in waste diversion (19.7% recyclables by 2024), financial sustainability (37.3% revenue surplus in 2023/24), and solar infrastructure. However, regulatory delays (11 pending Bylaws and user fees) and infrastructure gaps (no municipal laboratory) persist. Recommendations focus on expediting Bylaws approvals and enhancing climate resilience.

Waste Management: Waste management is improving, with recycling rates rising from 6.7% to 15.6% (2022–2024). However, challenges remain in hazardous waste handling, illegal dumping, and lack of disposal and treatment facilities.

Biodiversity Management: Biodiversity is declining due to invasive species (22% of municipal land), wetland disturbances, habitat fragmentation, and limited management resources. Conservation successes include 42% land under protection and community-based programs, but urgent action is needed to reverse invasive species spread.

Freshwater Management: Infrastructure expansion has improved water access, but wetland disturbances, water quality remains a concern, with persistent E. coli, turbidity, and fluoride exceedances. Public health risks and environmental degradation are ongoing. Recommendations include investment in treatment technology and laboratory capacity.

Land Use Management: Land use is improving with managed urban expansion and green space preservation (18% of land), but challenges remain in public land scarcity and infrastructure maintenance.

Energy Management: Energy management is improving, with increased renewable adoption and efficiency measures. However, projected demand surges require urgent infrastructure upgrades and regulatory reform.

Air Quality & Climate Change: Air quality and climate indicators show mixed trends. Recycling and solar initiatives have reduced emissions, but lack of direct

pollutant monitoring and continued reliance on external waste disposal are gaps. Climate impacts such as flooding and heat stress are rising, necessitating further investment in preparedness and restoration.

Public Health and Safety: Ezulwini's public health has improved in sanitation and healthcare access, with waste diversion increasing and expanded vaccination outreach. However, disease surveillance and environmental monitoring remain weak: waterborne disease tracking is absent, air quality is unmonitored, and only two inspectors manage compliance. Pressures include population growth and peri-urban waste, while strong policies and community engagement drive progress. Positive impacts are offset by illegal dumping and data gaps. Key gaps remain in real-time monitoring and air quality sensors, prompting recommendations for surveillance systems, lab upgrades, capacity building, and faster Bylaws promulgation.

Social and Well Being: Social well-being in Ezulwini has remained largely unchanged, with average quality of life, weak social cohesion, limited recreational opportunities, and persistent mental health challenges, though crime is gradually declining. Economic disparities, rapid urbanization, and service delivery gaps continue to drive these issues, while community watch programs and wellness initiatives offer some positive momentum. However, rising substance abuse and social isolation persist, and key gaps in mental health care, recreation, and social services highlight the need for integrated support systems and stronger infrastructure.

Culture and Heritage: Ezulwini's culture and heritage are stagnating, with new policies and pilot conservation projects unable to offset ongoing loss of traditional knowledge and site degradation. Urbanization and globalization threaten both physical monuments and intangible practices, while gaps in documentation, enforcement, and community participation persist. Without targeted funding and stronger institutions, only modest improvements are likely.

Overall, Ezulwini has made substantial progress in environmental management and sustainability, but persistent challenges in regulatory finalization, resource capacity, and inclusive planning remain. Accelerating reforms and targeted investments are essential for achieving long-term resilience and sustainability.

Ezulwini Background and Context

Ezulwini Municipality is strategically located within the Ezulwini Valley in the Hhohho Region of Eswatini, nestled between the country's administrative capital, Mbabane, and the commercial hub, Manzini (Figure 1). The town covers approximately 1,720 hectares and is bordered by the Mdzimba and Lugogo Mountains, with the Lusushwana and Mkhondolwane rivers marking its southern and northern boundaries, respectively. Established as a Town Board in 1995 and upgraded to a Town Council in 2012, Ezulwini has evolved from its origins as a tourism hub, home to the renowned Mlilwane Wildlife Sanctuary and the Royal Swazi Spa into a dynamic urban centre with a growing residential and commercial base. As of 2024, the population is projected at around 2,800, with land ownership predominantly private (59.4%), followed by government parastatals and the iNgwenyama in Trust for the Swazi Nation.

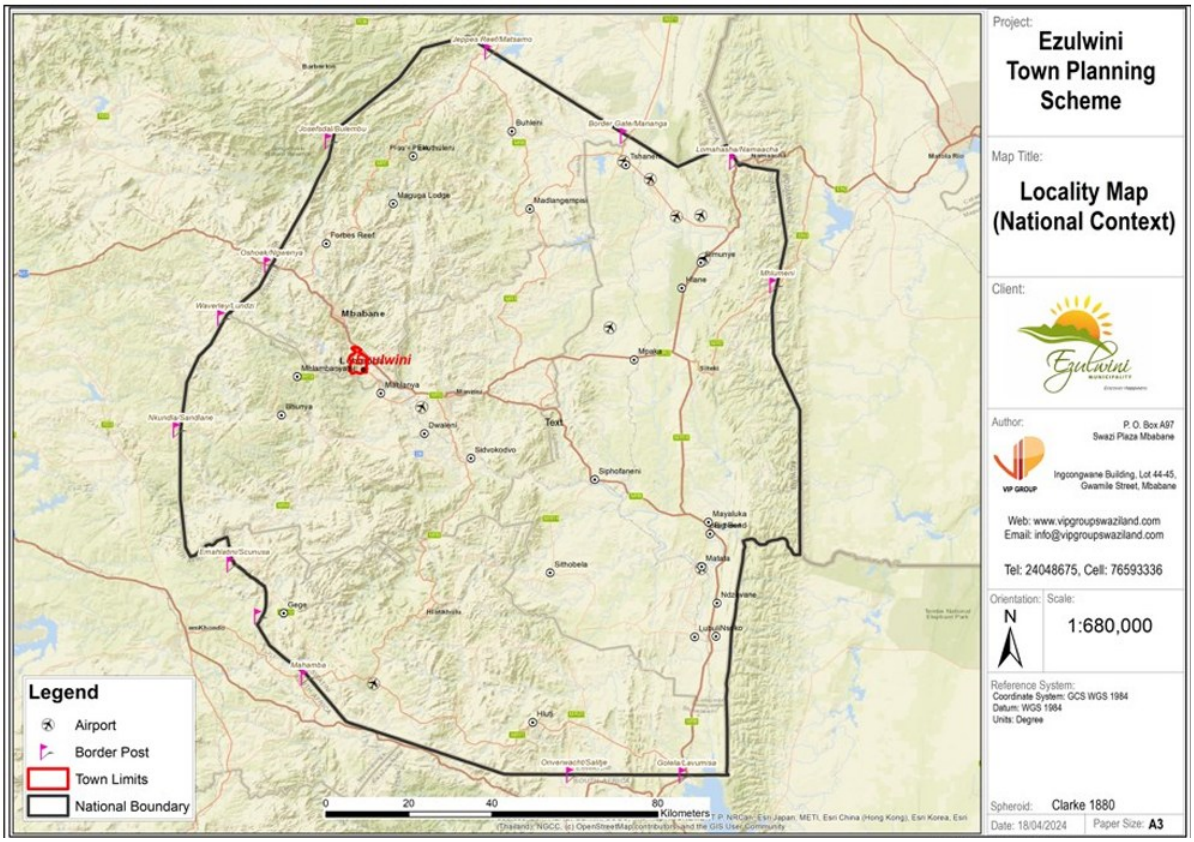

Figure 1: Ezulwini Town Locality Map (Ezulwini Municipality, 2024)

The Municipality is divided into six wards, primarily residential in nature (over 60% of plots), with Ward 4 alone accounting for 47% of residential properties (Figure 2). Commercial activity is concentrated along the MR103 corridor, which also connects key shopping centres and hospitality establishments. Governance is provided by a Council of eight members, six elected from the wards and two appointed by the Minister of Housing and Urban Development supported by an administration comprising five main departments: Corporate Services, Public Health and Environment, Town Planning, Treasury, and Works & Maintenance, with an additional Social Services Department. The Council's strategic direction is set out in the

Integrated Development Plan (IDP), which prioritizes financial sustainability, governance, infrastructure development, Local Economic Development (LED), and resource mobilization, and is closely aligned with the United Nations Sustainable Development Goals (SDGs), particularly SDG 11 on sustainable cities.

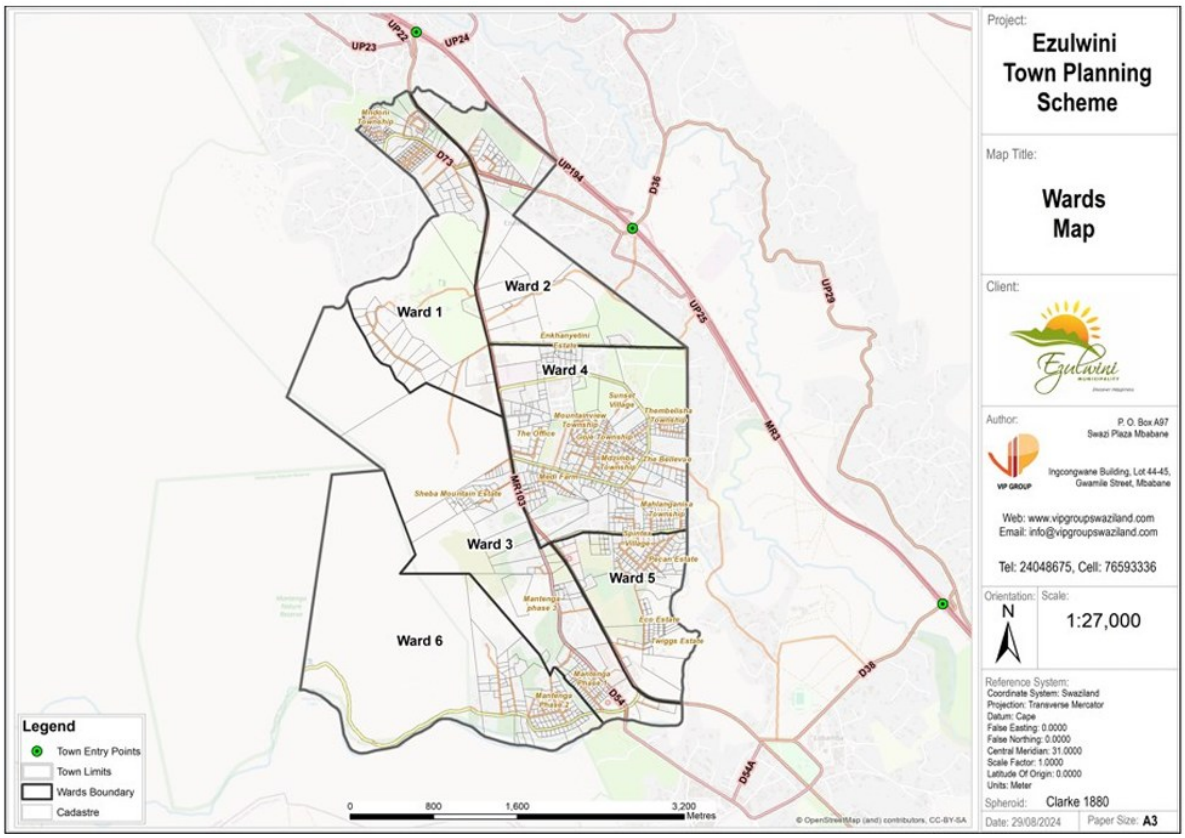

Figure 2: Ward map for Ezulwini (Ezulwini Municipality, 2024)

Ezulwini, aptly named the "place of heaven," is renowned for its breathtaking scenery, mountainous terrain, and verdant valley. Ezulwini Valley contains diverse habitats such as grasslands, woodlands, and riverine systems, supporting numerous plant and animal species. The area is home to important wildlife reserves, including the Mlilwane Wildlife Sanctuary, which covers over 4,500 hectares and provides refuge for native wildlife, as well as Mantenga Nature Reserve, which protects over 700 hectares of natural habitat near the Mantenga Falls. These areas play a vital role in conserving flora and fauna, including some species unique to the region. The town and its environs are distinguished by an abundance of natural attractions, including wildlife sanctuaries, hot springs, expansive golf courses, and a variety of other tourist destinations. Visitors and residents alike enjoy a wealth of amenities such as hotels, casinos, shopping centres, restaurants, craft markets, art galleries, and equestrian facilities.

The broader Ezulwini Valley, which encompasses Lobamba, the traditional capital of Eswatini, has long served as a centre of rich historical and cultural significance within the country. Ezulwini's strategic location, picturesque landscapes, and established reputation as Eswatini's premier tourism and entertainment hub have fuelled rapid

urbanisation, elevating the town to one of the nation's most prominent urban centres. In recent years, Ezulwini has experienced a notable increase in the number of corporate organizations, establishing a burgeoning business district poised to rival those of Mbabane and Manzini. This dynamic growth has reinforced the town's economic viability and prospects for future expansion, safeguarding property values and enhancing Ezulwini's stature on a national scale.

The Purpose of the State of Environment Report (SOER)

The Context of the SOER

The State of Environment Report for Ezulwini provides a comprehensive analysis of the town's environmental conditions, challenges, and opportunities within both national and global sustainability frameworks. As a rapidly urbanising Municipality in Eswatini's central corridor, Ezulwini faces increasing pressures from population growth, tourism, and commercial development, which normally result in land degradation, pollution, waste management challenges, and heightened climate vulnerability.

The report aligns Ezulwini's issues with international frameworks such as the 2030 Agenda for Sustainable Development, the Paris Agreement, and the Convention on Biological Diversity, highlighting the need for integrated policies and regular monitoring. While Eswatini's Environment Management Act (2002) requires regular State of Environment Reports, national assessments have not adequately addressed the unique challenges faced by rapidly evolving towns like Ezulwini.

The Approach and Methodology

The State of Environment Report (SOER) for Ezulwini employed a rigorous, multi-faceted methodology centred on the DPSIR Framework (Drivers-Pressures-State-Impacts-Responses) to structure its analysis. Below is a detailed breakdown of the approach.

DPSIR Framework Application

The report adopted the DPSIR model to establish causal relationships between socio-economic activities and environmental outcomes. Figure 3 summarizes the DPSIR framework applied to review Ezulwini Municipality's state of environment.

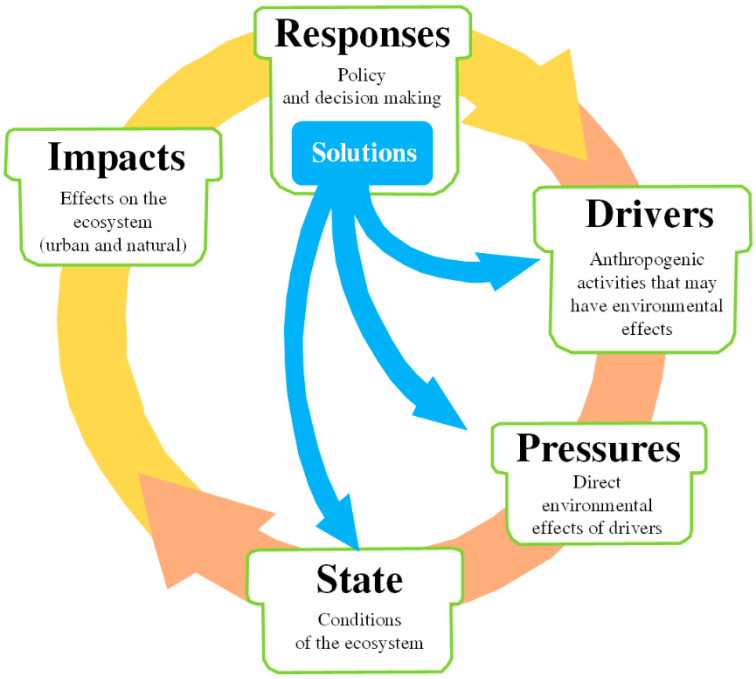

Figure 3: DPSIR Framework applied in Ezulwini Municipality SOE Review (Ternell et.al, 2023)

Indicator Framework Development

A custom indicator framework was designed to operationalize DPSIR, approved by the Ezulwini Town Council. Table 1 shows the approved indicators for Ezulwini Municipality SOER.

Table 1: Approved Indicators for Ezulwini Municipality SOER

Thematic Area	**Proposed Indicators**
Environmental Governance	- Environmental policies and regulations - Budget allocations for environmental initiatives - Public participation in environmental decision-making - Environmental compliance of local businesses
Waste Management	- Solid waste generation and collection rates - Hazard waste generation rates - Recycling rates - Wastewater treatment capacity and efficiency - Illegal dumping sites
Freshwater Management	- Available Water sources - Water quality data - Water consumption rates - Water source protection measures
Public Health	- Incidence of waterborne diseases - Air pollution-related health issues - Access to healthcare facilities - Sanitation coverage - Health and Safety Incidences
Land Use	- Land use patterns and changes - Green space coverage - Urban development plans - Population density - Green city initiatives and implementation
Biodiversity Management	- Species diversity - Protected area coverage - Invasive species prevalence - Habitat fragmentation
Air Quality and Climate	- Air pollutant levels - Greenhouse gas emissions - Climate change impacts - Adaptation and mitigation measures
Energy	- Energy consumption patterns - Renewable energy adoption - Energy efficiency measures - Access to electricity
Culture and Heritage	- Cultural sites and monuments inventory - Traditional practices and knowledge - Cultural events and participation - Heritage conservation efforts
Social and Well-being	- Quality of life indicators - Social cohesion and community engagement - Access to recreational facilities - Mental health and well-being statistics

	- Crime rates and types - Social pathologies (e.g., substance abuse, domestic violence)
Cross-cutting Issues	- Gender equality in environmental decision-making - Youth involvement in environmental initiatives - Poverty-environment linkages - Environmental education and awareness - HIV prevalence and impact on environmental management

Data Collection and Triangulation

Data was gathered through mixed methods to ensure robustness:

- Surveys: 100 randomly sampled residents from Ezulwini provided localized insights on environmental perceptions.
- Structured consultations: Interviews with key entities:
    - *Government*: Ezulwini Municipality, Eswatini Environment Authority (EEA), Ministry of Health, Eswatini Police
    - *Utilities*: Eswatini Water Services Corporation (EWSC), Eswatini National Trust Commission (ENTC).
    - *Experts*: Specialists in biodiversity, psychology, and climate resilience.
- Data triangulation: Cross-verified findings via:
    - Methodological triangulation: Combining survey results, interviews, and document analysis.
    - Data-source triangulation: Synthesizing community inputs, institutional records, and scientific studies.

State Evaluation Methodology

Environmental "state" was classified as improving, declining, or stagnant using:

- Trend analysis: Longitudinal comparison of indicators (e.g., erosion rates, pollution levels).
- Threshold assessment: Benchmarking against national/environmental standards (e.g., water quality indices).

Gap Analysis and Recommendations

Findings were mapped to:

- Policy alignment: Recommendations integrated into the Ezulwini Integrated Development Plan (IDP) and national strategies (e.g., National Development Plan 2023–2028).

- Response strategies: Prioritized actions addressing gaps in governance, resource allocation, and climate adaptation.

Chapter 1: Environmental Governance and Sustainability

"Sustainability means responsibly meeting the needs of present generations without compromising the ability of future generations to meet their own needs." United Nations

1.1 Overview

Ezulwini Municipality has demonstrated measurable **improvement** in environmental governance and sustainability between 2019-2024, achieving significant waste diversion (19.7% recyclables by 2024) and robust financial sustainability (37.3% revenue surplus in 2023/24). Key drivers include community-centred programs like the Waste Separation at Source initiative and strategic investments in solar infrastructure. However, urbanization pressures, regulatory delays (11 pending Bylaws), and infrastructure gaps (e.g., no municipal laboratory) constrain full potential. Climate vulnerabilities persist, with high faecal coliform levels in rivers and fragmented disaster preparedness. Recommendations focus on accelerating Bylaws approvals, expanding circular economy infrastructure, and enhancing climate resilience.

1.2 Background and Context

Ezulwini operates within the national regulatory framework provided by the Environment Management Act (2002), The Public Health Act (1969), The Urban Government Act (1969),The Town Planning Act (2016), The Building Act (1968), The Rating Act (1995), The Occupational Safety And Health Act (2001), The Waste Regulations (2000), The Environmental Audit, Assessment and Review Regulations (2022), The Water Act (2003), National Environmental Policy, The Natural Resources (Public Streams Banks) Regulations, Eswatini National Biodiversity Policies and Strategy and Plan, and is further guided by international frameworks such as the SDGs and the African Union's Ezulwini Consensus (2005), which emphasizes collective security and institutional reform. Appendix 1 contains a detailed summary of applicable regulatory framework. The Municipality's commitment to sustainable development is reflected in its ongoing efforts to localize the SDGs, implement quality management systems, and foster inclusive, resilient urban growth through participatory governance and strategic partnerships.

1.3 State of Environmental Governance and Sustainability

1.3.1 Environmental and Social Services Provided

Ezulwini Municipality generally provides a coordinated range of services aimed at maintaining a clean, healthy, and well-planned urban environment while supporting the well-being and development of its residents. In the environmental sphere, the Municipality typically ensures regular management of waste, oversees public health standards, and monitors environmental quality, including addressing nuisances such as overgrown properties and encouraging responsible resource use. Health-related services are focused on safeguarding food safety, promoting public health through inspections and certifications, and supporting disease prevention and community wellness, often in partnership with national health authorities and other stakeholders.

Social services are oriented toward supporting vulnerable groups, promoting social inclusion, and fostering community development. This includes providing early childhood care, facilitating home-based care, and promoting awareness on public health and social issues. The Municipality also works to empower residents through

educational outreach and skills development, while engaging the community in participatory initiatives and commemorative events that address social challenges.

On the infrastructural and town planning front, the Municipality is responsible for maintaining and upgrading essential infrastructure such as roads, street lighting, and stormwater drainage, as well as guiding orderly urban growth through town planning schemes and land-use management. Collaborative efforts with external organizations, such as universities, government ministries, and development partners, help enhance the quality and sustainability of these services, ensuring that Ezulwini continues to develop as a safe, inclusive, and resilient urban center. Table 2 summarizes the relevant Ezulwini Town Board stakeholders.

Table 2: List of Relevant Stakeholders and their Roles

Stakeholder	**Mandate/Role**
Ezulwini Municipality (Town Council)	Local authority responsible for urban governance, service delivery, development planning, social services, and oversight of environmental management.
Eswatini Environment Authority (EEA)	Regulates and enforces environmental policies, monitors pollution, water quality, and coordinates national environmental assessments and reports.
Eswatini Water Services Corporation (EWSC)	Provides potable water supply, sanitation, and maintenance of water infrastructure.
Ministry of Natural Resources & Energy (MNRE)	National oversight of water resources, energy policy, and environmental sustainability.
Department of Water Affairs	Management and protection of national water resources, catchment planning, and flood control.
Eswatini National Trust Commission (ENTC)	Conservation of natural and cultural heritage, management of reserves, environmental education.
Lobamba Traditional Authority	Custodianship of communal land and traditional governance, mediation on land use, local traditions, and cultural values.
Universities (e.g., UNESWA)	Research, internships, technical training, community outreach, and environmental studies.
Food and Agriculture Organization (FAO)	Supports sustainable agrifood systems, food safety, and capacity building via programs like ACE, focusing on integrated 'One Health' approaches.
Ministry of Health	Oversight of public health programs, hazardous waste management, and health education.
Ministry of Agriculture	Oversight of sustainable land use, control of invasive species, and promotion of sustainable agriculture.
Eswatini Tourism Authority	Promotes sustainable tourism development and manages tourism facilities in collaboration with the municipality.
Local Community Leaders & NGOs	Community mobilization, clean-up campaigns, environmental advocacy, and social services support.

1.3.2 Expenditure Analysis for Environmental Management and Sustainability in Ezulwini Municipality

Critical Observations from 2022 and 2023 financial information:

- Waste Management Efficiency: 50% cost reduction achieved through recycling initiatives.
- Renewable Energy Focus: Solar infrastructure budget increased to E582.9K (2023/24).
- Strategic Shifts: Capital expenditure redirected from buildings to environmental infrastructure.

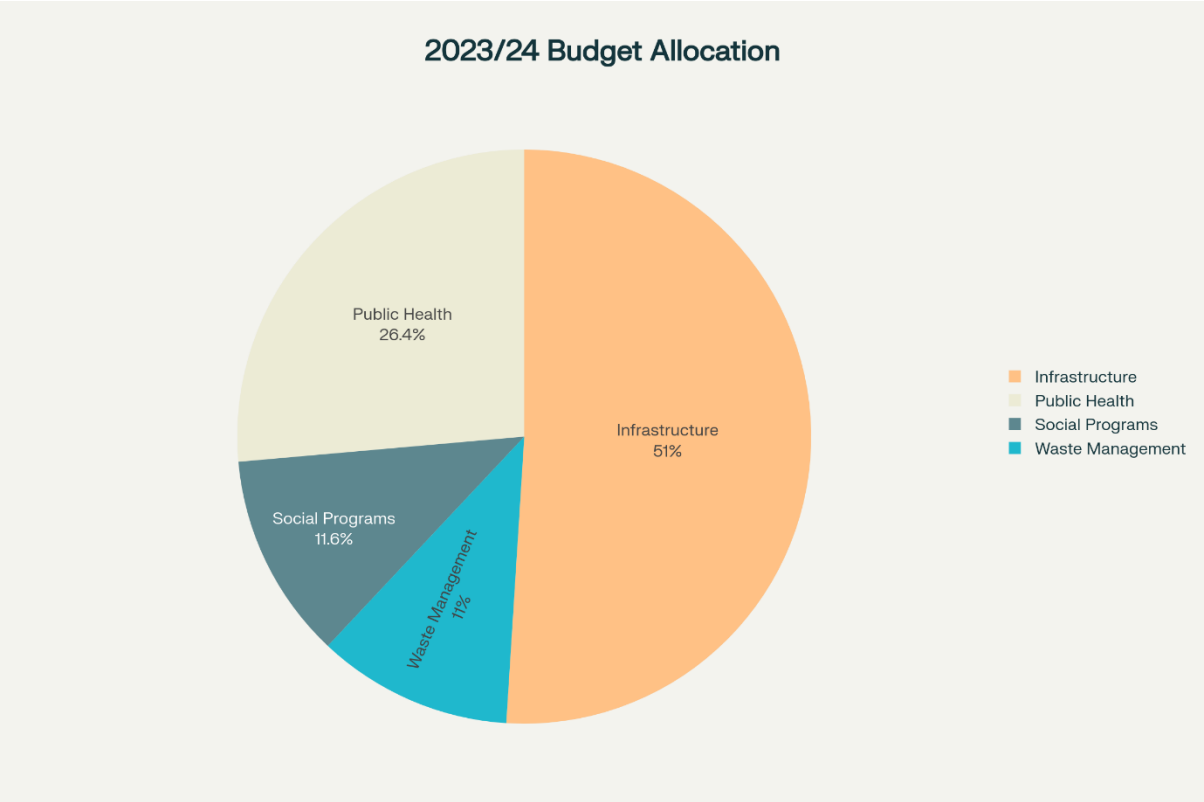

Figure 4: Budget allocation by category for Ezulwini Municipality in 2023/24

Figure 4 provides a snapshot of how the 2023/24 municipal budget is distributed across four main categories: Waste Management, Infrastructure, Public Health, and Social Programs. This visualization highlights the significant share allocated to infrastructure and waste management, reflecting the Municipality's ongoing focus on service delivery, environmental quality, and urban resilience. Public health and social programs, while smaller in proportion, still represent important investments in community well-being and sustainability.

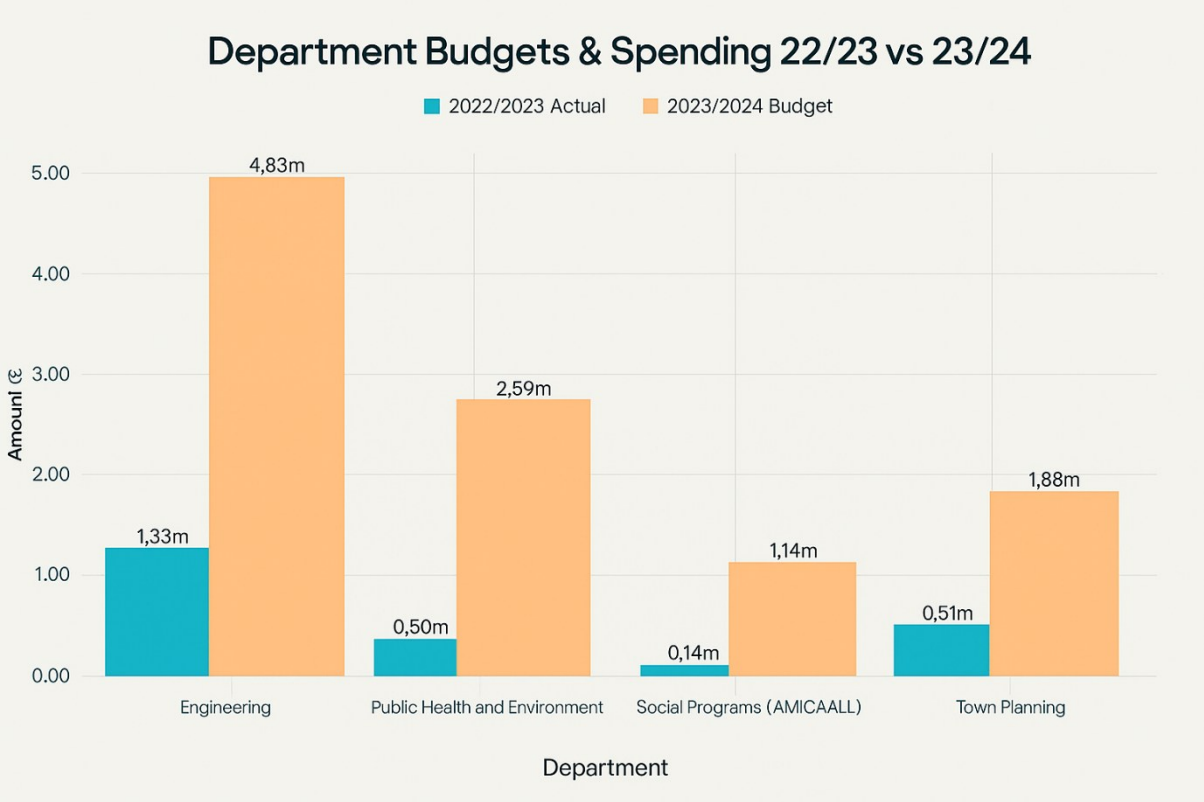

Figure 5: 2022/23 actual expenditure and 2023/24 budget for key departments in Ezulwini Municipality

Figure 5 compares actual expenditure for 2022/23 with the budget for 2023/24 for four key departments: Engineering, Public Health & Environment, Health and Social Well-being Services, and Town Planning. The visualization shows a notable increase in budget allocations for all departments, particularly Engineering and Social Services, indicating a strategic shift toward infrastructure upgrades and expanded social programming. Public Health & Environment and Town Planning also saw steady or increased funding, underscoring a balanced approach to urban management and sustainability.

1.3.3 Budget allocations for Environmental Health Services

Ezulwini has prioritized environmental investments, leveraging municipal surpluses and international loans. The USD 23 million African Development Bank (AfDB) loan funded critical water and sanitation projects, increasing water access to 71% and sanitation coverage to 64% (African Development Bank, 2019). Municipal surpluses, which grew by 33.8% to E11.7 million in 2023/24, largely financed waste collection vehicles and solar streetlights. Figure 6 compares 2022/23 and 2023/24 Budget Allocations for Public Health and Environmental Programs at Ezulwini Municipality.

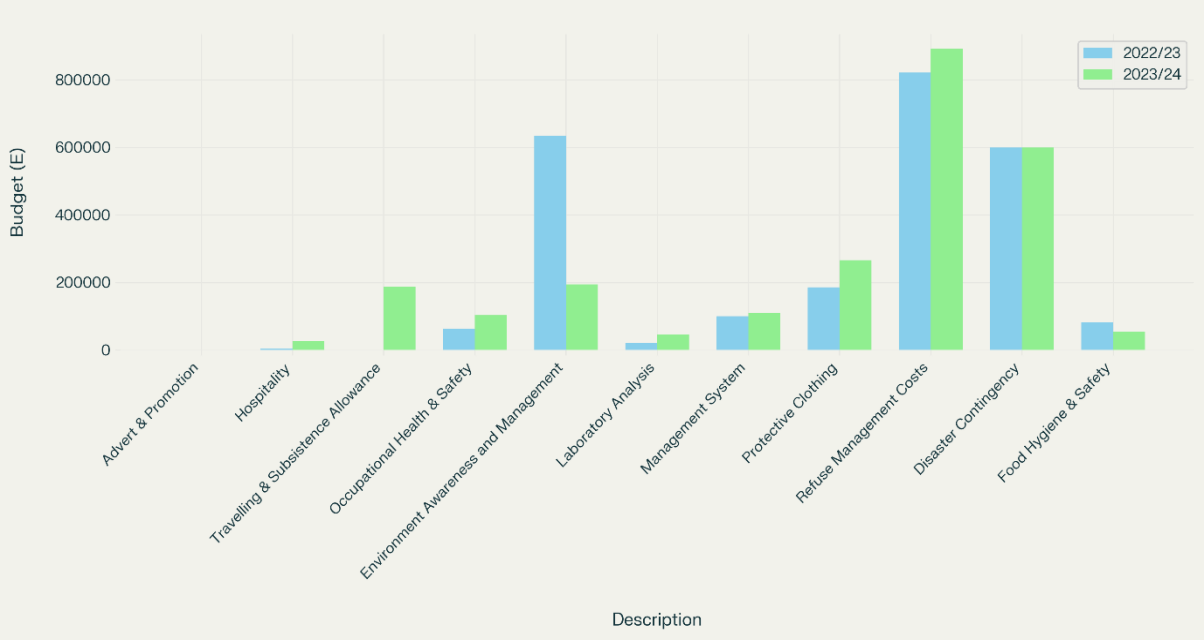

Figure 6: A Comparison of 2022/23 and 2023/24 budget for environmental management Programs at Ezulwini

The budget for environmental initiatives in Ezulwini Town for 2023/24 reflects shifts in priorities compared to 2022/23. Refuse management costs received the largest allocation at E891,440, representing an 8.5% increase from 2022/23 (E821,250). The disaster contingency fund allocation remained static at E600,000 across both reporting periods, with zero utilization recorded in each year due to the absence of qualifying disaster events. Protective clothing saw a significant increase (43.6%), while laboratory analysis funding more than doubled (131%), reflecting improved investment in monitoring systems. However, funding for environment awareness and management dropped by 69%, raising concerns about the Municipality's ability to educate the public and foster behavioural change. Food hygiene and safety allocations decreased by 32.8%, potentially compromising health standards.

The information generally demonstrates Ezulwini Municipality's commitment to scaling up investment in infrastructure and core environmental services, while also strengthening public health and social support systems. The upward trend in departmental budgets suggests a proactive response to urban growth, environmental pressures, and community needs. However, the gap between actuals and budgets in some departments points to the need for improved budget execution and possibly capacity building to ensure that planned initiatives are fully implemented for maximum impact.

1.3.4 Environmental Regulations and Compliance

1.3.4.1 Regulatory Framework Development

The Municipality operates under comprehensive national legislation including the Health Act, Environmental Management Act, and Urban Government Act. Eleven draft Bylaws addressing critical gaps in national legislation are currently under review by the Ministry of Housing and Urban Development. These Bylaws cover essential areas

including waste management, occupational health and safety and food safety to name a few. Table 3 summarizes the pending byelaws:

Table 3: Proposed Byelaws for Ezulwini

Byelaw Name	Core Focus	Main Provisions/Controls
Occupational Safety & Health Bye-law	Workplace safety & health	Safety/health standards, hazard ID, PPE, training, accident reporting, enforcement
Ezulwini Parking Bye-law	Orderly parking management	Parking restrictions, time limits, permits, enforcement, signage, disability access
Gated Community Bye-law	Regulation of private estates	Entry/exit, security, maintenance, common areas, governance, dispute resolution
Small Medium Enterprise (SME) Bye-law	Informal trade regulation	Trading areas, licensing, health standards, space allocation, integration, compliance
Ezulwini Waste Management Bye-law	Sustainable waste control	Collection/disposal, recycling, hazardous waste, illegal dumping, fees, engagement
Ezulwini Food Safety Bye-law	Public food safety	Hygiene standards, establishment standards, training, inspections, recalls, enforcement
Noise Control Bye-law	Limit noise pollution	Noise limits, prohibited sources, quiet hours, enforcement, abatement measures
Environmental Management Bye-law	Protect environment & resources	Pollution control, EIAs, land use, resource protection, enforcement, education
Ezulwini Fire Bye-law	Fire prevention/protection	Fire standards, inspections, equipment, outdoor burning, fireworks, awareness
Public Nuisances Bye-law	Address community disturbances	Prohibited acts, property upkeep, animal control, health/sanitation, abatement
Accommodation Establishments Bye-law	Regulate lodging facilities	Licensing, health/safety, zoning, sustainability, noise, accessibility, compliance

1.3.4.2 Compliance Monitoring and Enforcement

Environmental monitoring covers 100% of major construction projects, with Environmental Evaluation Studies required before project commencement. Seven major projects underwent environmental monitoring in 2023/24, ensuring compliance with the Environment Management Act of 2002.

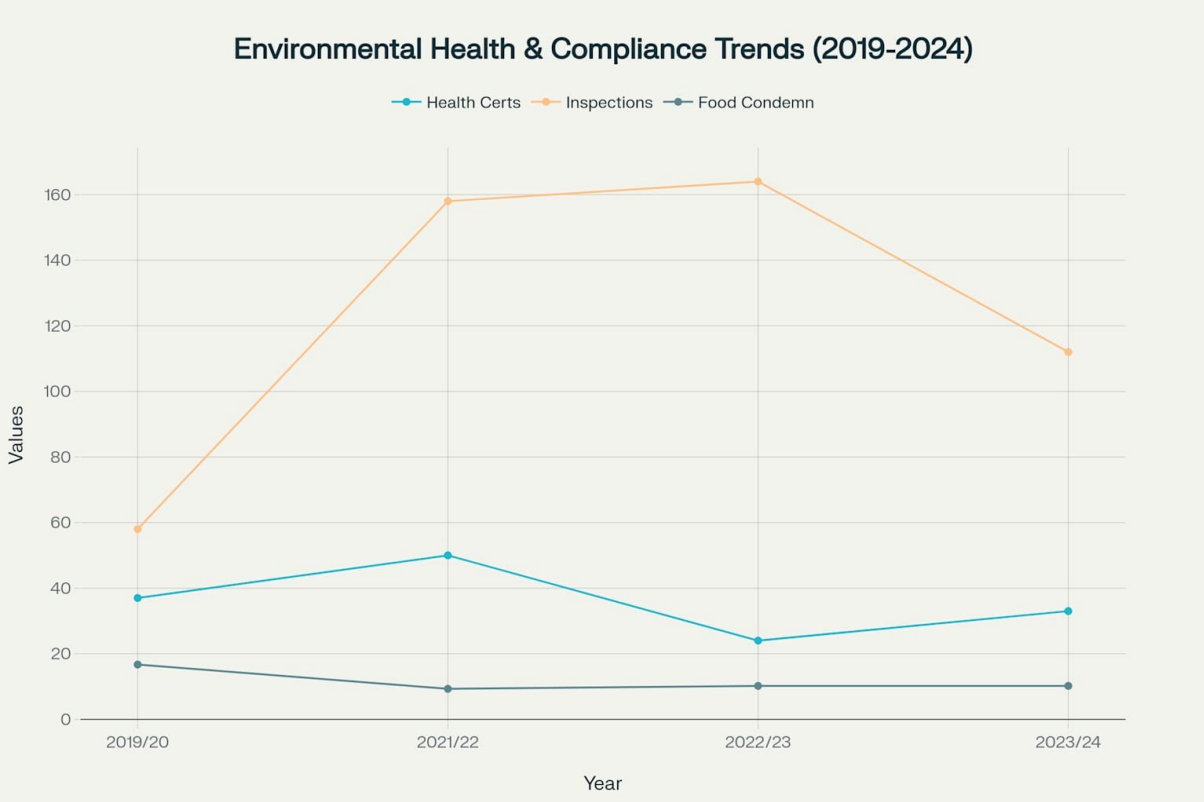

Figure 7: Environmental Health & Compliance Monitoring Trends (2019-2024)

Figure 7 shows environmental health and compliance monitoring trends for Ezulwini. Inspections are the key monitoring methods applied by the Municipality. This includes inspection of food and business premises and property. Property compliance for overgrown vegetation management achieved a 72% owner compliance rate, with 50 property owners served with court orders in 2023/24. Of these, 36 property owners (72%) eventually complied by clearing their properties either voluntarily or after legal proceedings commenced. Food safety compliance remained robust, with zero major environmental incidents reported during the review period. The Municipality condemned 10.2 tons of expired and damaged food items in 2023/24, demonstrating proactive public health protection.

1.3.5 Partnership and Collaboration

Strong collaborative relationships exist with the Eswatini Environment Authority (EEA), Ministry of Health, and Ministry of Agriculture. However, challenges persist with some regulatory partners, particularly Eswatini Water Services Corporation (EWSC), where relationships have been strained due to environmental compliance issues during major infrastructure projects.

1.3.6 Public Participation in Environmental Decision Making

1.3.6.1 Stakeholder Engagement Mechanisms

The Municipality employs multiple platforms for public participation in environmental decision-making. The Annual General Meeting (AGM) held each year provides formal opportunity for residents and businesses to contribute input on municipal direction and environmental priorities. Ward meetings for Integrated Development Plan (IDP)

consultations, stakeholder validation sessions for Bylaws development, and social media platforms enable ongoing community communication. However, the Municipality acknowledges limitations in mainstreaming vulnerable groups including women, youth, and people with disabilities in environmental planning.

1.3.6.2 Community Environmental Programs

The Waste Separation at Source Program exemplifies community-centred environmental management, engaging 20 youth volunteers from peri-urban communities in door-to-door education and material sorting. The program's success in Ward 4 demonstrates effective community mobilization and environmental behaviour change.

Figure 8: Public Participation in Environmental Programs showing youth engagement and household waste program reach

Figure 8 indicates that youth empowerment programs showed variable participation levels, with 90 participants in the UNDP Youth Empowerment Programme in 2022/23, compared to 25 participants in entrepreneurship programs in 2021/22. The 2023/24 waste separation program reached 500 households, representing a significant expansion in community engagement.

1.3.7 Environmental Education and Awareness

Comprehensive environmental education programs target multiple stakeholder groups. Four schools participated in waste management training programs, healthcare facilities received specialized training on waste segregation requirements, and public awareness campaigns during World Environment Day commemorations engaged diverse community members. Community partnerships extend to peri-urban areas,

with active collaboration in Ebuka for establishing a buy-back centre addressing illegal dumping challenges. The Municipality works effectively with traditional leadership including local committees and traditional leadership structures.

1.4 Pressures and Driving Forces

1.4.1 Key Pressures

The key pressures include:

- Increased urbanization in recent years which has resulted in increased pressure on natural resources and management.
- Infrastructure deficits: 23km haul to Matsapha disposal site; One Environmental Health Officer and One Public Health Officer in the Public Health and Environment Department.
- Climate vulnerabilities: The Disaster Management Plan for Ezulwini identifies floods/fires as top hazards; drought stress from invasive alien plants.
- Regulatory gaps: Ministerial delays in Bylaws approvals averaging 1-2 years and
- Peri-urban communities surrounding Ezulwini and the accompanying environmental impacts.

1.4.2 Driving Forces

Key driving forces include:

- Strong policy frameworks: IDP's 70% waste diversion target driving circular economy investments.
- Effective community action: Waste Separation Program engaging 35 youth volunteers and 1,200 households (2024).
- Working partnerships: UNDP youth skills training (90 participants); Forestry Department collaboration on invasive species control.
- Financial innovation: Additional solar streetlights reducing energy costs; recycling cutting waste expenses.

1.5 Impacts

1.5.1 Positive Impacts

Positive environmental impacts include:

- 139% increase in recyclables (2019-2024), diverting 2,286 tons annually from landfills.
- 85 indigenous trees planted; 12 km² invasive species cleared along MR103 corridor.

Positive social impacts include:

- 376 home visits for health education (2023/24); Gender-Based Violence Summit addressing underreporting.

Positive public health impacts include:

- Rabies vaccination for 78 dogs/1 cat; 60% food establishments rated Grade A.

Positive economic impacts include:

- Cost savings: Waste collection expenses halved to E30, 000 - 40, 000/month.

1.5.2 Negative Impacts

Negative impacts include:

- Environmental Impacts:
  - Illegal dumping from peri-urban areas (Ebuka, Lobamba) contaminating water sources.
  - Water contamination in Mkhondolwane/Lusushwana rivers due to operations like the informal Cuddle Puddle Hot springs.
- Governance Impacts:
  - Hazardous waste mismanagement due to lack of dedicated facilities.
  - Exclusionary engagement: Limited programs target people with disabilities.

1.6 Responses

1.6.1 Institutional and Programmatic

Waste management responses include:

- *Waste Separation at Source:* Waste diversion towards recycling in Ward 4; expansion to 1,200 households.
- *Cost Efficiency:* Recycling reduced collection costs.

Disaster preparedness responses include:

- Disaster Management Plan implementation with fire hydrant assessments and commercial emergency drills.

Compliance enforcement responses include:

- 100% environmental monitoring of construction projects; 72% property clearance compliance.

Community Engagement responses include:

- Youth volunteer programs (20 door-to-door educators); 4 schools in waste management training.

1.6.2 Technological and Infrastructure

The following technologies and infrastructure were adopted in Ezulwini:

- Renewable Energy: 85 solar streetlights installed across 6 residential streets. These are additional to solar streetlights installed at Ligugu Street and other streets in Ward 3 and 6.
- GIS Implementation: Enhanced spatial planning for service delivery optimization.

1.7 Critical Gaps

Critical gaps include:

- Regulatory: Draft Bylaws pending ministerial approval (2024), weakening enforcement.
- Resource capacity: One Environmental Health Officer and One Public Health Officer in the Public Health and Environment Department; no municipal laboratory for real-time testing.
- Infrastructure: Dependency on distant disposal site (Matsapha); no materials recovery facility.
- Stakeholder coordination: Relations with Eswatini Water Services Corporation (EWSC) need to be strengthened.
- Data gaps: Lack of vulnerability assessments for marginalized groups.

1.8 Recommendations

Critical recommendations for improved environmental governance and sustainability include:

- Expediting Bylaws Approvals: Establish dedicated liaison with Ministry of Housing and Urban Development.
- Piloting Hazardous Waste Collection: Partner with Eswatini Environment Authority for dedicated waste streams.
- Vulnerability Mapping: Conduct targeted assessments for women, youth, and people with disabilities.
- Developing Materials Recovery Facility: Secure land acquisition for circular economy infrastructure.
- Climate Integration: Embed flood/drought resilience into urban planning using GIS tools.
- Regional Waste Consortium: Formalize partnerships with peri-urban communities for illegal dumping mitigation.

- IoT-Enabled Monitoring: Implement sensor networks for real-time water/air quality tracking.

1.9 Conclusion

Ezulwini's environmental governance has improved measurably since 2019, evidenced by waste diversion successes, financial resilience, and community engagement. However, urbanization pressures, regulatory delays, and climate vulnerabilities threaten sustained progress. The state is improving but requires accelerated reforms in regulatory finalization, inclusive planning, and climate-resilient infrastructure. By prioritizing Bylaws approvals, circular economy infrastructure, and targeted vulnerability assessments, Ezulwini can solidify its position as a regional sustainability leader while addressing systemic gaps.

Chapter 2: Waste Management

"We are trashing our only home," said by the UN Secretary-General

2.1 Overview

The state of waste management in Ezulwini has been **improving** over recent years, marked by significant gains in diversion rates through the launch of source-separation program, despite rising collection volumes and persistent challenges in hazardous waste handling and illegal dumping. Commercial and residential waste collected rose from 2.210 tonnes in 2022–23 to 2.290 tonnes in 2023–24, yet recycling diversion increased from 6.7% to 15.6% over the same period. Key pressures include rapid peri-urban growth, limited municipal staffing (two inspectors), high disposal costs due to 23km travel to Matsapha Landfill, and inadequate hazardous waste segregation. Driving forces encompass strong municipal leadership, national and international policy alignment, community engagement, and multi-stakeholder partnerships. Impacts are both positive (waste diversion increases, cost savings, youth employment) and negative (environmental degradation, health risks, enforcement gaps). Responses include a waste separation at source programme, infrastructure upgrades, enforcement measures, and disaster preparedness integration. Critical gaps remain in hazardous waste systems, laboratory capacity, enforcement resources, and peri-urban infrastructure. Recommendations focus on expanding capacity, formalizing Bylaws, establishing hazardous waste facilities, enhancing regional collaboration, and investing in local disposal and testing infrastructure.

2.2 Background & Context

Waste management falls under the Urban Government Act (1969), reinforced by the Environment Management Act (2002) and Waste Regulations (2000) at a national level, and guided by the National Solid Waste Management Strategy. Internationally, Eswatini adheres to the Basel, Stockholm, and Rotterdam Conventions on hazardous substances, aligns with Sustainable Development Goals (SDG 11, 6, 13), and recently adopted Municipal Bylaws awaiting promulgation to enforce source-segregation, fines, and user fees.

2.3 State of Waste Management

2.3.1 Solid Waste Collection Rates

Ezulwini has witnessed a steady and significant increase in solid waste collection over the four-year period from 2020 to 2024:

- 2020/21: 1,459 tonnes
- 2021/22: 1,816 tonnes (24.5% increase from previous year)
- 2022/23: 2,206 tonnes (21.5% increase from previous year)
- 2023/24: 2,286 tonnes (3.6% increase from previous year)

This represents a cumulative increase of 56.7% over the four-year period, with the most dramatic rise occurring between 2020 and 2023. This dramatic rise can be attributed to the rapid urbanization in recent years at Ezulwini with over 100 approved residential and commercial developments. The tapering growth rate in 2023/24 may

indicate a stabilization of waste generation patterns or reflect the impact of recent waste reduction initiatives. Collection frequency was reduced from twice weekly to weekly to control operational costs, yet service quality was maintained through enhanced routing efficiency and waste separation initiatives that lowered disposal expenses from E50,000–60,000 to E30,000–40,000 per month. Figure 9 details the waste collection trends at Ezulwini over recent years:

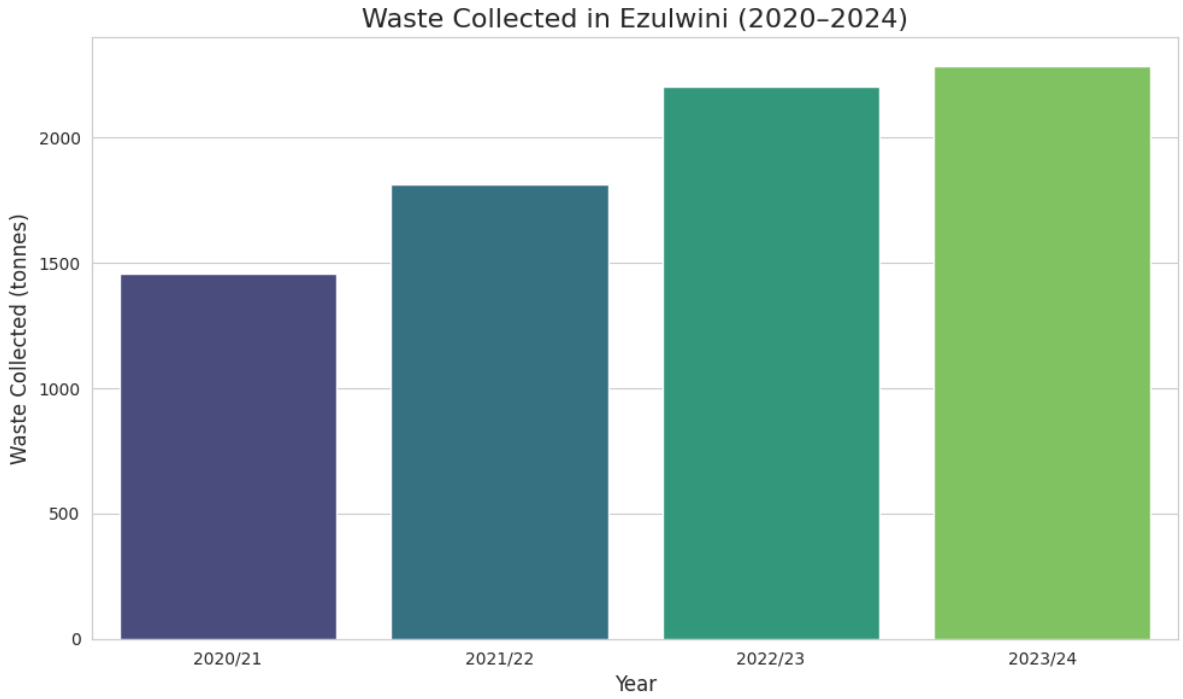

Figure 9: Waste Collection Trends 2020 - 2024 for Ezulwini

2.3.2 Waste Collection Analysis

- Commercial Waste grew from 1.047 tonnes in 2021–2022 to 1,363 tonnes in 2022–2023 (+30.2 %), then fell to 1.273 tonnes in 2023–2024 (–6.6 percent). Its share of total waste declined from 61.8 percent in 2022–2023 to 55.7 percent in 2023–2024, reflecting effective commercial-sector reduction measures. Construction and demolition waste particularly from the ICC Construction site contributed to the 21% increase, 47% increase of organic waste post festive season compared to 38% during festive season.
- Residential Waste increased from 631 tonnes in 2021–2022 to 694 tonnes in 2022–2023 (+10.0 percent), then decreased to 651.5 tonnes in 2023–2024 (–6.1 percent). Its proportion of total waste fell from 31.5 percent to 28.5 percent over the same interval, indicating improved household practices. See Figure 10 depicting the waste trends from 2021-2024.

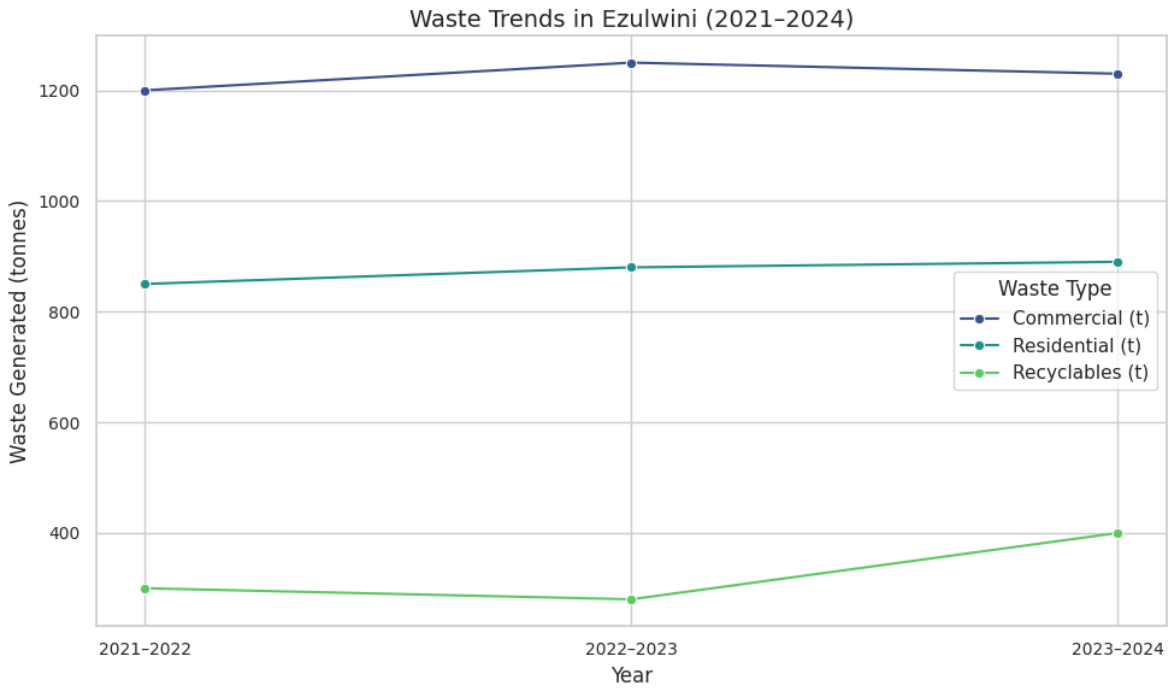

Figure 10: Trends in Commercial, Residential and Recyclable Waste (2021-2024)

2.3.3 Waste Generation Rates

Waste generation and collection are projected to increase steadily from 2025 to 2034, the amount of waste generated will consistently outpace the amount collected, resulting in a widening gap and indicating that a growing volume of waste will remain unmanaged over time (Figure 11).

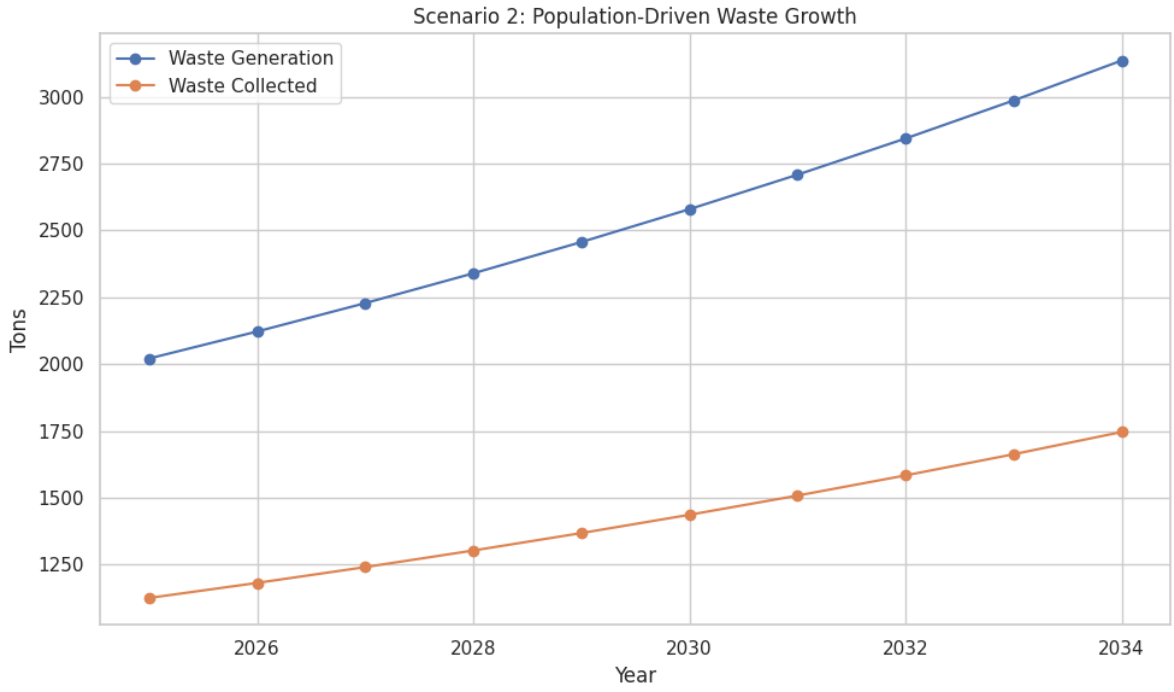

Figure 11: Population-driven Waste Growth for Ezulwini

The figure illustrates that between 2025 and 2034, both waste generation and waste collection in a population-driven scenario are projected to rise steadily; however, waste generation (starting just above 2,000 tons and surpassing 3,100 tons) consistently outpaces waste collected (which grows from about 1,100 tons to approximately 1,750 tons). This growing disparity highlights that an increasing amount of waste will remain uncollected each year, which could contribute to greater environmental degradation through illegal dumping, pollution, and heightened public health risks. The persistent and widening gap underscores the urgent need for enhanced waste management capacity and strategic policy interventions to address the escalating challenge of unmanaged waste.

2.3.4 Hazardous Waste Generation and Management

2.3.4.1 Healthcare Risk Waste

Six healthcare facilities Medisun Clinic, Clicks Pharmacy, Ezulwini Pharmacy, Artemis, Ezulwini Private Hospital, and Ezulwini Clinical Laboratory Services produce risk waste which is disposed at the Matsapha incinerator under contractual arrangements. Monthly records on waste volumes are submitted to Ezulwini to ensure regulatory compliance. Incinerated waste increased by 1.73 tonnes in March 2025 and a decline of 1.1 tonnes was observed in April 2025.

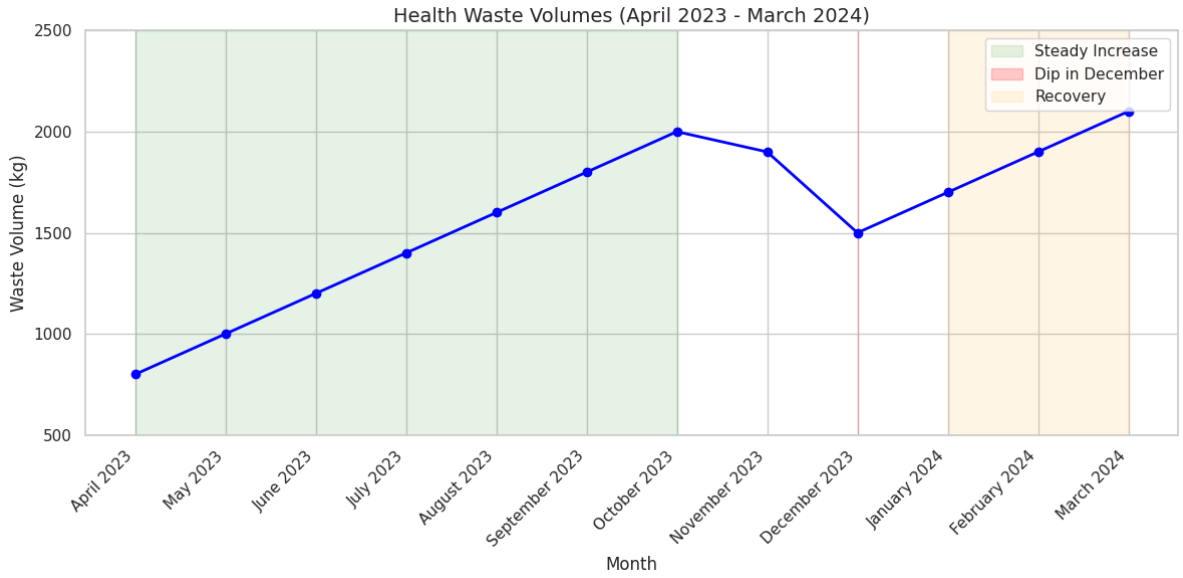

Figure 12: Monthly Healthcare Waste Volumes in Ezulwini Municipality (2023/2024)

The monthly data for 2024 reveals several important patterns including:

- Seasonal Variation: Healthcare waste volumes show significant monthly fluctuation, ranging from 600kg (April 2023) to 2600 kg (March 2024).
- Upward Trend: There's a clear upward trajectory throughout the year, with the second half averaging 57.5% higher volumes than the first half.
- Peak Period: October 2023 recorded the highest single-month volume at 2600kg tonnes, while March 2024 reached 2600kg.

- Volatility: Monthly volumes varied by 333.3% between the lowest and highest months.

The seasonal and rising fluctuations in healthcare waste volumes place heavy stress on waste management systems; this increases the risk of improper disposal, pollution of air, soil, and water, and exposure to pathogens and toxic substances, especially during peak months, ultimately threatening both environmental quality and public health if robust, flexible treatment capacity and monitoring systems are not maintained.

2.3.4.2 Condemned Food Items

Strict food-safety enforcement reduced confiscated food from 16.6 tonnes kg in 2019–2020 to 9.2 tonnes in 2021–2022, then stabilized at about 10.2 tonnes in 2022–2023 and 10.2 tonnes in 2023–2024, indicating stronger compliance among food establishments. Figure 13 presents the annual volumes of expired and damaged food items condemned in Ezulwini over four financial years. It highlights fluctuations in public health enforcement and food safety compliance efforts by municipalities.

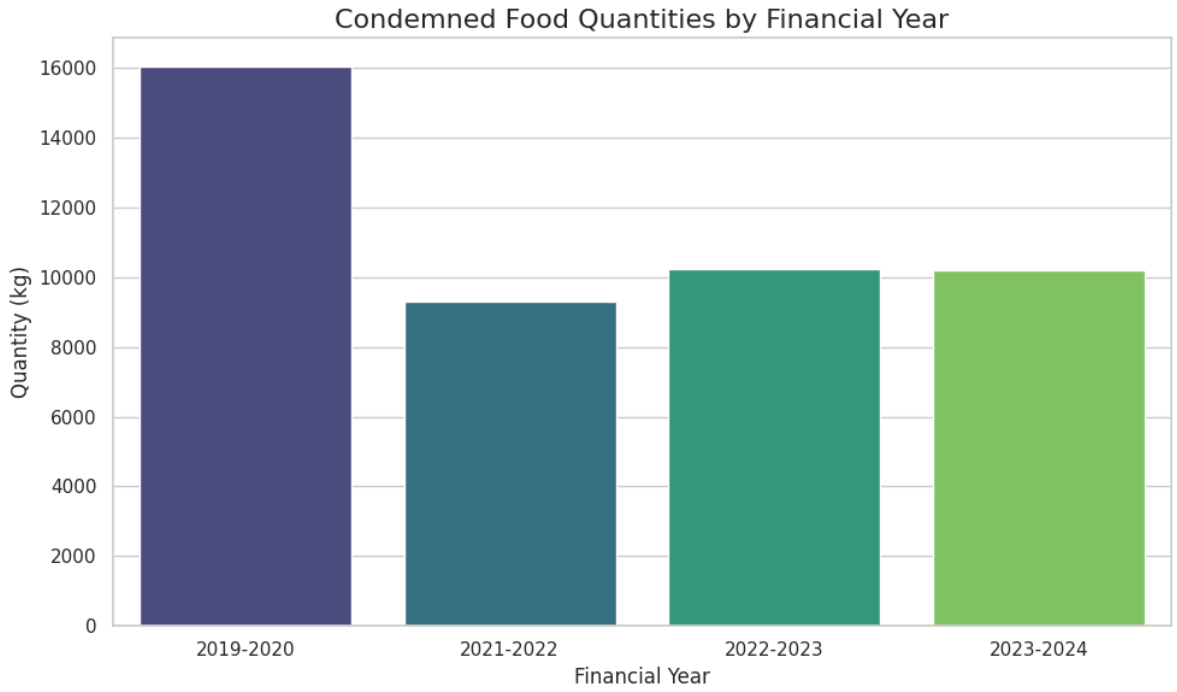

Figure 13: Annual Condemned Food Volumes in Ezulwini (kg)

Key observations include:

- 2019–2020 saw the highest condemnation volume at 16,656 kg, reflecting rigorous inspections.
- A sharp decline to 9,288 kg occurred in 2021–2022, likely due to reduced operations during COVID-19 lockdowns.
- Condemnations rose to 10,240 kg in 2022–2023 after inspections resumed fully.

- A slight decrease to 10,200 kg in 2023–2024 suggests consistent enforcement.

2.3.5 General Hazardous Waste

Household hazardous waste (e.g., bulbs, paint) is mixed with general refuse due to:

- Lack of source-segregation system for hazardous items
- Lack of specialized collection infrastructure for this type of waste
- Disposal framework for segregated hazardous waste not yet developed

2.3.6 Waste Minimization

2.3.6.1 Recycling Performance

Recyclable waste increased from 138 tonnes in 2021–2022 to 149 tonnes in 2022–2023 (+8.0 %) and surged to 356 tonnes in 2023–2024 (+139.3 percent), accelerating the recycling rate from 6.7 percent to 15.6 percent of total waste over the years. Collected recyclables are stored at the temporary holding facility, currently used as an Agroecology Training and Demonstration Centre (ATDC). This program preserves the economic value of recyclables, reducing landfill volumes, and easing the logistical burden on the local authority. The proposed byelaws mandates source segregation and outlines responsibilities, penalties, and incentives to ensure compliance. Figure 14 shows a composite photograph of the temporary holding facility for the recyclable waste at the ATDC Centre.

Figure 14: Program for Recycling at the Agroecology Training and Demonstration Centre

2.3.6.2 Waste Minimization Program

Waste Separation at Source

The programme was launched as a pilot on November 20, 2023, in Ward 4 of Ezulwini's waste, and serves 500 households as follows:

- Collection of recyclable waste on Mondays
- Further Sorting sessions on Tuesdays
- 20 youth volunteers engaged under the program
- Awareness facilitated through Door-to-Door

2.3.7 Waste Characterization Studies

The town conducted a Waste Characterization study on the 17th – 20th March 2025 to study waste trends in the town over various seasons. The Waste Wise Cities Tool and Methodology was used to ensure environmental controls. A similar study was conducted in December 2024 presenting the Overall Waste Composition in Ezulwini Urban Area. The studies were conducted during and post festive seasons. The results indicate that organic waste is the dominant stream with increases from 38% to 47% for the reporting periods while a decline of 13% to 9% was observed for paper and cardboard over both periods. Further decline of 14% to 10% was noted for glass over the same periods. This can be attributed to high food consumption, high demand for packaging materials during the festive season and high consumption of alcohol increasing demand for glass waste streams. However, the organic waste streams continued to increase during both seasons way after residents return from holidays. This present effective opportunities for the food waste segregation and composting green initiatives for the town. Figure 15 summarizes Overall Waste Composition in Ezulwini Urban Area – December 2024 and March 2025.

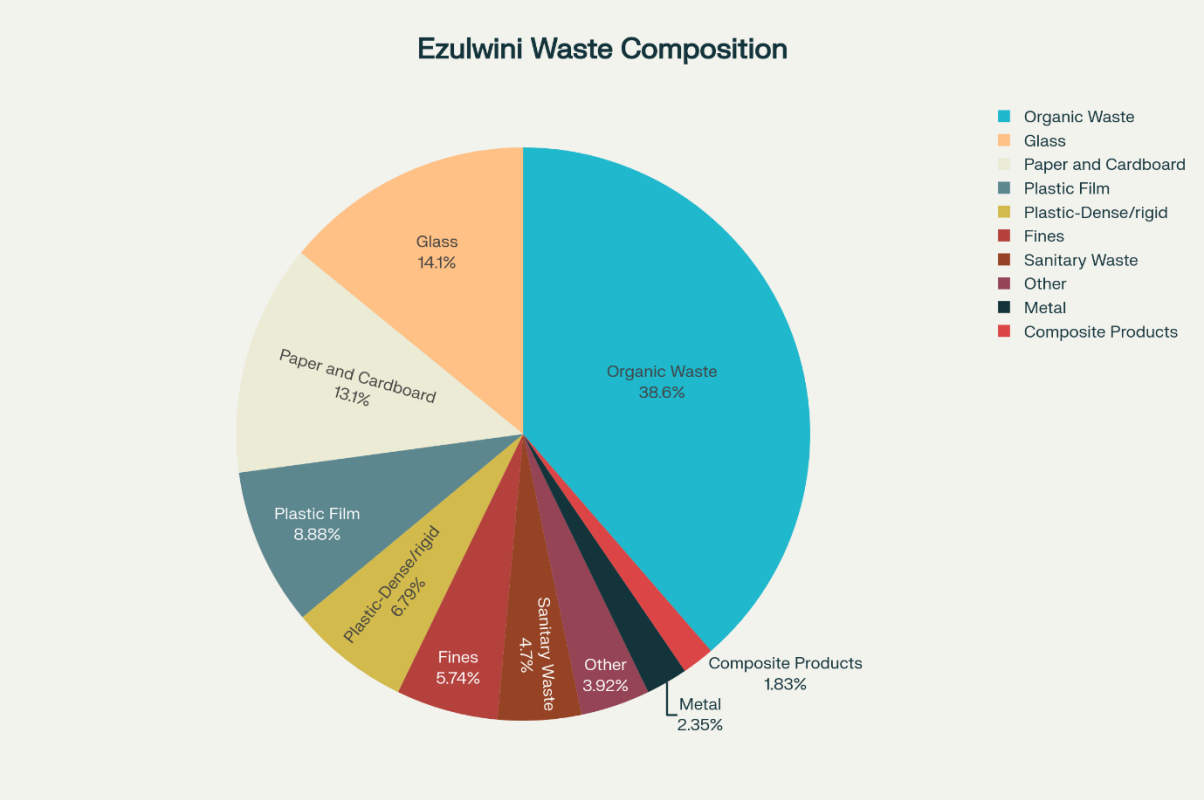

Figure 15: Waste Composition in Ezulwini (December 2024 – during festive season)

Key Insights: Waste Composition in Ezulwini Urban Area
These include:

- Organic Waste constitutes the largest portion at 38.6% of the total waste stream. This dominance signals a major opportunity for Ezulwini to prioritize the development of large-scale organic waste diversion initiatives such as composting, which would significantly reduce landfill dependency and methane emissions.
- Glass makes up 14.1% of the waste, representing a substantial recyclable fraction. This justifies scaling up glass recycling collections and processing facilities, as capturing even a portion could make a notable impact on overall diversion rates.
- Paper and Cardboard account for 13.1%, reinforcing the importance of fibre recycling programs and presenting another high-yield area for recovery and reduction of landfill-bound waste.
- Plastic Film (8.88%) and Plastic-Dense/rigid (6.79%) together comprises 15.67%. This illustrates the ongoing need for comprehensive plastic recovery programs and public education on plastics sorting.
- Fines (5.74%) and Sanitary Waste (4.7%) make up smaller but significant categories, each requiring specialized handling to minimize health and environmental risks.
- Other Waste (3.92%), Metal (2.35%), and Composite Products (1.83%) are present in minor proportions but still offer opportunities for targeted collection and recycling streams.

Prioritizing resource allocation and infrastructure development for organics, glass, and paper diversion will yield the greatest environmental and operational gains for the municipality. A second waste characterisation study was conducted in March 2025 indicating increases of 21% construction and demolition (C&D) waste particularly from the ICC Hotel and 47% increase in organic waste due to varying consumption patterns during and post festive season (4 – QMS PHE Monthly Report April 2025) and Figure 16 below shows the Post Festive Season Overall Waste Composition of Ezulwini Urban Area – March 2025.

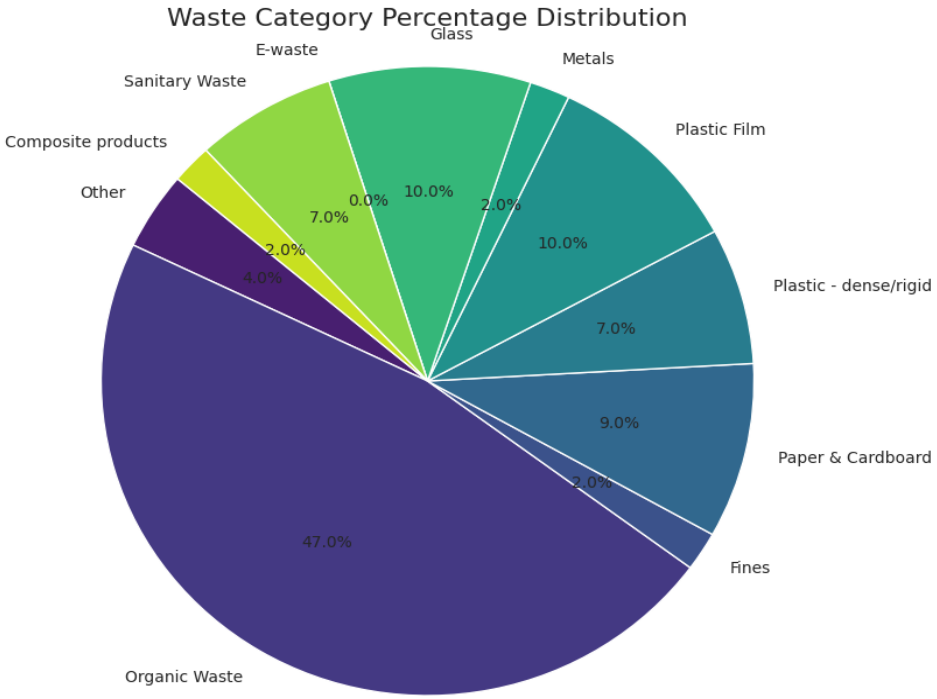

Figure 16: Post Festive Season - Overall Waste Composition of Ezulwini Urban Area – March 2025

2.3.8 Wastewater Treatment Capacity and Efficiency

Wastewater from Ezulwini and other nearby areas are managed by the Eswatini Water Services Corporation (EWSC) through a plant designed for a future capacity of 10 ML/day. Its sewerage network spans 60 km locally, with a 19 km outfall sewer conveying all flows to the central Matsapha treatment facility. Treatment adheres to the Water Pollution Control Regulations (2010) under Eswatini's Environmental Authority. EWSC's ISO-accredited laboratory conducts continuous influent and effluent monitoring to ensure compliance. Recent data show overall effluent compliance at 69.5%, with ongoing upgrades to enhance performance.

2.3.9 Illegal Dumping

There are several illegal dumps within Ezulwini. Within the residential zones the illegal dumps largely consist of garden waste and in the areas closer to peri-urban areas the waste is of domestic origin. Figure 17 shows some of the illegal dumps observed in Ezulwini.

Figure 17: Illegal Dumping Sites Observed in Ezulwini

Relevant challenges include:

- Neighbouring peri-urban communities (Lobamba, kaBhelina, Mvutjini and Nyonyane) lack waste management services and facilities which had a knock-on effect on services and facilities provided by Ezulwini.
- Ongoing dumping on vacant undeveloped plots.
- Shift of hotspots as enforcement relocates focus: Municipal responses feature targeted buy-back centres, security patrols, court orders for overgrown plots, and proactive source-level interventions.

2.3.10 Infrastructure & Coverage

2.3.10.1 Waste Collection Fleet

The Ezulwini Municipal Council has implemented a dual-vehicle waste collection system that handles an average of 6.1 tonnes of waste daily. The Municipality currently operates one compactor truck for residential sector and two skip trucks for non-recyclables at the commercial sector and a dedicated 1 tonne truck for recyclables, enabling contamination-free collection and enhancing overall waste management

efficiency. Waste collection coverage in Ezulwini is structured and systematic, as evidenced by the provided compactor schedule and skip bin distribution map. The area benefits from a weekly waste collection service, with clearly designated collection days at residential level that ensure waste is managed efficiently across various wards.

Additionally, the strategic placement of skip bins in private properties generating commercial waste enhances accessibility, particularly in high-density and commercial areas. This approach not only supports routine waste disposal but also helps to maintain cleanliness and public health standards. The combination of scheduled collections and well-distributed skip bins demonstrates a proactive commitment to comprehensive 100% waste management coverage in Ezulwini. Household refuse is collected weekly on a fixed schedule, ensuring consistent service to all residential plots. Figure 18 shows the waste collection routes for Ezulwini.

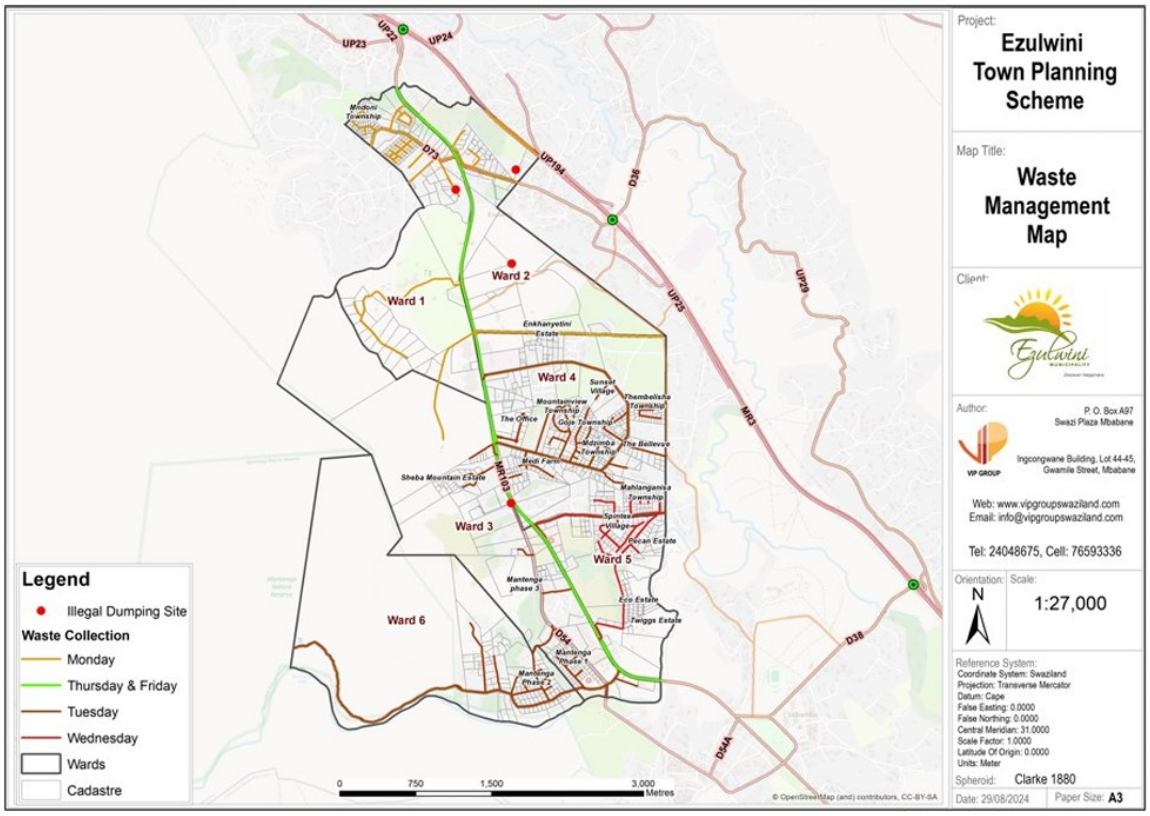

Figure 18: Waste collection routes for Ezulwini (Ezulwini Municipality Town Planning Scheme, 2024)

2.3.11 Wastewater Treatment

Ezulwini's water and sanitation network is provided by Eswatini Water Services Corporation and delivers full urban coverage as follows:

- Sewer Connections: 578 properties are linked to the town's 58.5 km trunk and collection network, discharging via a 19km outfall sewer to the Ezulwini treatment plants, one in Ebuka and the other in Ecansini. This system ensures safe disposal and compliance with national effluent standards.

2.4 Pressures & Driving Forces

2.4.1 Pressures

The pressures include the following:

- Urban growth: fast population increase and peri-urban influx, stressing collection and disposal systems.
- Financial constraints: weighbridge fees coupled with 23km haul to Matsapha Landfill inflate monthly disposal costs, necessitating reduced collection frequency.
- Human resources: two officers for all public health and environment functions hinder compliance enforcement.
- Regulatory lag: 11 Bylaws drafted all pending promulgation (1–2 years), limiting local enforcement.

2.4.2 Driving Forces

These include:

- Municipal leadership: proactive Waste Management Plan (WMP) and Integrated Development Plan (IDP) targets (70 % diversion by 2049).
- Policy alignment: national laws (EMA, NSWMS) and international conventions (Basel, SDGs) shape municipal strategies.
- Community engagement: door-to-door campaigns, youth volunteers, and stakeholder forums fuel program uptake.
- Partnerships: collaborations with UNDP, JICA, EEA, and private sector support technical and financial resources.

2.5 Impacts

2.5.1 Positive

These include:

- Recycling surge: 139 % increase in recyclables in 2023–24 resulting in savings on disposal costs (from E60 000 to E40 000 monthly). During peak tourism seasons and holidays, the savings figures are higher.
- Source-separation programme: Ward 4 diversion rate increased by March 2024; volunteers empowered 500 households.
- Community & youth: 20 volunteers employed; environmental awareness and civic pride improved.

2.5.2 Negative

These include:

- Illegal dumping: peri-urban residents lack waste disposal facilities, leading to dumping waste within the town and misuse of public bins; shifting focus on hotspots strain enforcement.
- Hazardous waste mismanagement: no systematic collection, bulbs, paint enter general waste; lack of plan for segregation and handling of hazardous waste.
- Public health risks due to hazardous waste mixing with general waste and illegal dumping incidences

2.6 Responses

These include:

- At-Source Waste Separation Programme: currently in Ward 3,4 and 6 of the town. launched November 2023 in Ward 4; weekly recyclables collection and sorting; expansion planned.
- Regulatory development: 11 Bylaws drafted for local waste fees, fines, and segregation mandates; awaiting promulgation.
- Infrastructure planning: IDP includes land acquisition for Materials Recovery Facility (MRF) and local disposal site; public-private site proposals with Authorities on Swazi Nation Land.
- Enforcement measures: Court orders for 50 overgrown plots resulted in 72% compliance; Illegal dumping fines and security rangers deployed.
- Disaster integration: street hydrant audits, fire/emergency drills, EIA compliance monitoring for construction projects.

2.7 Critical Gaps

These include:

- Hazardous waste system: absence of collection points and disposal infrastructure for household and general hazardous waste. The lack of a risk register to help identify, assess and mitigate the risks associated with hazardous and healthcare waste in a systematic way should be prioritised.
- Human resources: inadequate staffing in Public Health & Environment (PH&E) and Safety Health Environment and Quality (SHEQ) functions.
- Regulatory enforcement: developed byelaws in draft phase are of no effect pending promulgation; interim mechanisms needed.
- Peri-urban integration: limited waste services outside urban boundaries perpetuate cross-area dumping.
- Integrated waste management plan which must outline the long-term plan for management and or disposal of Ezulwini waste.

2.8 Recommendations

These include:

- Expanding staffing & skills: recruit additional Public Health Inspector and Environmental Officer and a permanent DRR personnel; invest in relevant training to boost required knowledge under the field.
- Accelerating Bylaws promulgation: liaise with parent Ministry to fast-track approval of local draft byelaws and support enforcement of penalties embedded within existing acts.
- Establishing hazardous waste system with a risk register: launch centralised collection points, partnerships with licensed facilities, and educate public on segregation, handling and disposal of hazardous waste.
- Development of a comprehensive waste management strategy inclusive of a holistic plan for hazardous waste management should be considered in future plans.
- Acquire land for waste disposal site and MRF: finalize feasibility studies, secure funding/partnerships for the establishment of a local waste disposal site within Swazi Nation Land.
- Invest in a local laboratory: develop cost-effective food and water testing laboratory for rapid on-site analysis.
- Enhance peri-urban waste inclusion: replicate the establishment of buy-back centres in all peri-urban wards, through cost-sharing agreements with regional stakeholders.
- Strengthen data & monitoring: conduct seasonal waste composition studies, digital tracking systems, and community-based reporting platforms.

2.9 Conclusion

Ezulwini's waste management system is **improving**, notably in waste diversion, yet continues to face significant pressures from urban growth, financial constraints, and resource limitations. The Municipality's proactive policies, partnerships, and pilot programs demonstrate strong driving forces. Addressing critical gaps in hazardous waste management, laboratory capacity and enforcement staffing will be essential to sustain progress and achieve long-term waste diversion and environmental health goals. With targeted investments and regulatory enhancements, Ezulwini can continue its trajectory toward a resilient, sustainable, and green urban environment.

Chapter 3: Biodiversity Management

"Without nature, we have nothing. Without nature, we are nothing." - United Nations

3.1 Overview

Ezulwini Municipality, located in Eswatini's Upper Middleveld, represents a critical biodiversity hotspot within the kingdom's smallest administrative area of 1,720 hectares. Despite its compact size, the Municipality supports three distinct ecosystems, Afromontane escarpment forest, grassland, and aquatic systems while maintaining 42% of its area under conservation management. However, the Municipality faces unprecedented biodiversity challenges, with invasive alien plant species covering 374 hectares (22% of total area) and high annual management costs. The overall state of biodiversity in Ezulwini is **declining**, evidenced by the expansion of invasive species over the past 15 years, continued habitat fragmentation from urban development, and the vulnerable status of endemic species. While conservation efforts through protected areas and community initiatives provide positive responses, the rate of degradation exceeds recovery efforts, indicating an urgent need for enhanced management strategies and increased resource allocation to reverse this declining trend.

3.1.1 Background: Local National and International Policy Framework

Ezulwini's biodiversity management operates within a comprehensive framework of national and international commitments that guide conservation strategies and implementation approaches. At the international level, the Government of Eswatini has ratified and domesticated key Multilateral Environmental Agreements (MEAs) including the Convention on Biological Diversity (CBD), UN Framework Convention on Climate Change (UNFCCC), and Convention to Combat Desertification (CCD). These agreements have been translated into national action plans that are monitored and reported through national consultative reports, with municipalities serving as delegated implementers for the MEAs through localized action plans.

The national regulatory framework is anchored by the Flora Protection Act (2001) and Environmental Management Act (2002), which provide legal backing for protecting indigenous species and controlling invasive alien plants. These acts establish schedules of protected flora, with species like *Pterocarpus angolensis* (Kiaat) protected under Schedule A and *Aloe marlothii* protected under Schedule C. Additionally, the Waste Regulations (2000) and associated environmental health regulations provide mechanisms for pollution control and habitat protection. The Eswatini National Trust Commission plays a crucial role in managing protected species demonstrating institutional coordination between national and local conservation efforts. At the municipal level, Ezulwini has integrated Sustainable Development Goals into departmental strategies, with each department aligning with relevant SDG targets to mainstream biodiversity conservation into urban planning and development processes. This multi-tiered governance approach creates a coherent framework linking global commitments to local implementation, though gaps remain in strategic environmental assessment and comprehensive invasive species management.

3.2 State of Biodiversity

3.2.1 Species Diversity

3.2.1.1Flora

Ezulwini's plant diversity reflects its position within the buffer zone of the Barberton Centre of Bird Endemism, supporting numerous protected and endemic species. Key conservation-worthy flora includes *Pterocarpus angolensis* (Kiaat), protected under Schedule A of the Flora Protection Act, and the near-endemic *Senecio mlilwanensis* (Daisie), listed as vulnerable by the IUCN and under review for threatened status. The Municipality also hosts protected species such as *Aloe marlothii* (Mountain Aloe) and *Cussonia* spp. Cabbage Trees alongside indicator species like *Syzygium cordatum* (Waterberry) that signal healthy wetland ecosystems. Table 4 shows key plant species reported to be observed in Ezulwini.

Table 4: Key Indigenous and Notable Plant Species

Name (Common)	Scientific Name	Species Diversity/Type	Condition & Status	Significance
Kiaat	*Pterocarpus angolensis*	Indigenous, Protected	Protected (Sched. A), Threatened	Valuable timber, ecological, medicinal
Mountain Aloe	*Aloe marlothii*	Indigenous, Succulent	Protected (Sched. C), Stable	Pollinator support, traditional uses
Daisie	*Senecio mlilwanensis*	Near-endemic, Herb	Vulnerable (IUCN)	Rare, habitat-specific
Cabbage Tree	*Cussonia spicata*	Indigenous, Tree	Protected, Stable	Soil stabilizer, iconic tree
Common Protea	*Protea afra*	Indigenous, Shrub	Stable	Ecological importance
Waterberry	*Syzygium cordatum*	Indigenous, Indicator	Stable	Wetland health indicator
Wild Phalsa	*Bridelia micrantha*	Indigenous, Tree	Stable	Riparian, abundant
River Bushwillow	*Combretum erythrophyllum*	Indigenous, Tree	Stable	Riparian, soil conservation
Tassel-berry	*Antidesma venosum*	Indigenous, Tree	Stable	Edible fruit, common
Large-leaved False-thorn	*Albizia versicolor*	Indigenous, Protected	Protected (Sched. B), Vulnerable	Vulnerable flora
Forest Tree Fern	*Alsophila dregei*	Indigenous, Fern	Protected (Sched. B), Vulnerable	Vulnerable flora
Forest Fever-berry	*Anthocleista grandiflora*	Indigenous, Tree	Protected (Sched. B), Vulnerable	Vulnerable flora

Highlights include:

- Ezulwini supports a mix of indigenous and invasive plant species, with several trees and herbs listed as protected or vulnerable, such as *Pterocarpus angolensis* and *Senecio mlilwanensis*.
- The presence of indicator species like *Syzygium cordatum* signals healthy wetland ecosystems, while the abundance of invasive plants (e.g. *Tithonia*

rotundifolia (Mexican Sunflower), *Solanum mauritianum*, *Vachellia mearnsii*) is a critical threat to native biodiversity.

- Conservation efforts are vital for species under threat, especially those protected under national legislation or listed as vulnerable by the IUCN.

Interpretations include:

- Indigenous flora is under increasing pressure from land use change and invasive species, but the persistence of protected and rare species highlights the ecological value of Ezulwini's remaining natural habitats.
- Invasive species are expanding rapidly, reducing ecosystem productivity and threatening water resources, which underscores the need for active management and restoration.

Figure 19: Endemic flora in Ezulwini (Cussonia spicata (Cabbage Tree) and Pterocarpus angolensis (Kiaat))

3.2.1.2Fauna

The faunal community demonstrates remarkable resilience despite urban pressures, with stable populations of antelope species including nyala, bushbuck, and impala. The area used to serve as critical habitat for rare and protected birds, including the Southern Ground Hornbill (*Bucorvus leadbeateri*) managed by the Eswatini National Trust Commission, and the endangered Blue Swallow (*Hirundo atrocaerulea*) that nests on Sheba's Breast Mountain. However, these birds are reported to have migrated

from the area in recent years. Human-wildlife conflict has emerged as both vervet monkeys (*Chlorocebus pygerythrus*) and Bush pigs (*Potamochoerus larvatus*) are identified as problem species despite their stable IUCN conservation status. Table 5 and 6 show mammals and birds observed in Ezulwini.

Table 5: List of Mammals observed in Ezulwini

Name (Common)	Scientific Name	Species Diversity/Type	Condition & Status	Significance
Vervet Monkey	*Chlorocebus pygerythrus*	Primate	Least Concern, Stable	Seed dispersal, ecosystem balance
Bush Pig	*Potamochoerus larvatus*	Ungulate	Least Concern, Stable	Soil turnover, crop raider
Nyala	*Tragelaphus angasii*	Antelope	Stable, Some Reintroduced	Browsing, prey species
Bushbuck	*Tragelaphus scriptus*	Antelope	Stable	Browsing, prey species
Impala	*Aepyceros melampus*	Antelope	Stable	Common grazer, prey
Warthog	*Phacochoerus africanus*	Ungulate	Stable	Soil aeration, prey
Porcupine	*Hystrix africaeaustralis*	Rodent	Present, Stable	Biodiversity indicator
Civet	*Civettictis civetta*	Carnivore	Present, Stable	Biodiversity indicator
Genet	*Genetta spp.*	Carnivore	Present, Stable	Biodiversity indicator
Leopard	*Panthera pardus*	Carnivore	Rare, Elusive	Top predator, ecosystem health
Grey Rhebok	*Pelea capreolus*	Antelope	Rare, Threatened	Conservation concern
Oribi	*Ourebia ourebi*	Antelope	Rare, Threatened	Conservation concern
Red Hartebeest	*Alcelaphus buselaphus caama*	Antelope	Rare, Threatened	Conservation concern

Highlights include:

- The mammal community is dominated by stable populations of antelope and primates, with rare sightings of top predators like leopard and threatened antelope such as grey rhebok and oribi.

- Species like the vervet monkey and bush pig are common but can be problematic due to human-wildlife conflict, especially crop raiding and disease transmission.
- The presence of elusive and rare species in protected areas underscores the importance of habitat conservation for maintaining mammal diversity.

Interpretations include:

- Stable populations of key herbivores and omnivores indicate functional ecosystems in protected and less-disturbed areas, but rare and threatened species are at risk from habitat loss and fragmentation.
- Human-wildlife conflict is an emerging management issue, particularly as urban expansion continues.

Table 6: List of Birds observed in Ezulwini

Name (Common)	Scientific Name	Species Diversity/Type	Condition & Status	Significance
Southern Ground Hornbill	*Bucorvus Leadbeater*	Large terrestrial bird	Rare, Protected (Reported to have migrated)	Forages in grasslands, managed by ENTC
Blue Swallow	*Hirundo atrocaerulea*	Swallow, Endemic	Endangered (IUCN) (Reported to have migrated)	Nests in Sheba's Breast, indicator species
Southern Bald Ibis	*Geronticus calvus*	Ibis, Endemic	Endangered (IUCN)	Indicator, endemic to region
Purple-crested Turaco	*Tauraco porphyreolophus*	Turaco	Common, Stable	Iconic, seed disperser
Shelley's Francolin	*Scleroptila shelleyi*	Francolin	Stable	Grassland health indicator
Fish Eagle	*Haliaeetus vocifer*	Raptor	Common, Stable	Top predator, water health indicator
Orange-breasted Waxbill	*Amandava subflava*	Waxbill	Stable	Seed disperser
Tambourine Dove	*Turtur timpanistria*	Dove	Stable	Forest and woodland species
Bateleur Eagle	*Terathopius ecaudatus*	Raptor	Stable	Iconic raptor
Cardinal Woodpecker	*Dendropicos fuscescens*	Woodpecker	Stable	Woodland health indicator
Black-eyed Bulbul	*Pycnonotus barbatus*	Bulbul	Stable	Common, seed disperser
Red-eyed Dove	*Streptopelia semitorquata*	Dove	Stable	Common, seed disperser
Laughing Dove	*Streptopelia senegalensis*	Dove	Stable	Common, seed disperser
Black Saw-wing Swallow	*Hirundo cucullata*	Swallow	Stable	Insect control
Red-breasted Swallow	*Hirundo semirufa*	Swallow	Stable	Insect control

Amethyst Sunbird	*Nectarinia amethystina*	Sunbird	Stable	Pollinator

Highlights include:

- Ezulwini is a significant birding area, supporting both common and rare species, including several globally threatened or regionally endemic birds such as the blue swallow and southern bald ibis.
- The diversity of birds, from raptors to seed dispersers and pollinators, reflects the habitat mosaic of forests, grasslands, and wetlands.
- The continued presence of endangered birds is an indicator of the ecological importance of Ezulwini's habitats, especially grasslands and escarpment forests.

Interpretations include:

- Bird diversity is high, with more than 500 species recorded in Eswatini and a significant proportion found in Ezulwini due to its varied ecosystems.
- Conservation of grasslands and wetlands is crucial for maintaining populations of rare and endangered birds, which are sensitive to habitat loss and disturbance.

Figure 20: Endangered/Rare Birds in Ezulwini (The Southern Ground Hornbill and the Blue Swallow reported to have migrated) (Birdlife, 2025)

3.2.3 Ecosystem Integrity

The Municipality's three distinct ecosystems demonstrate varying degrees of health and functionality. The Afromontane escarpment forest occupies approximately 60% of

intact ecosystems, primarily on the eastern slopes of Sheba's Breast Mountain extending into Mantenga Nature Reserve. The aquatic ecosystem, part of the Lusushwana River Catchment, is well-supported by extensive wetland systems, including the central wetland fed by Ezulwini's hot springs. Grassland ecosystems, though significantly reduced, persist in undeveloped areas and remain crucial for rainwater percolation and runoff management.

3.3 Pressures and Challenges

3.3.1 Primary Threats

3.3.1.1 Invasive Alien Plant Species

The most acute threat to Ezulwini's biodiversity comes from invasive alien plant species, which were identified in 2010 as having high infestations of six of the top ten invasive plants in Eswatini. Table 7 shows major invasive species found at Ezulwini.

Table 7: Invasive Plants found at Ezulwini

Common Name	***Scientific Name***	***Primary Habitats/Impacts***
Eucalyptus	*Eucalyptus spp.*	Roadsides, old stands, wetlands; intercepts groundwater, lowers pH
Pine	*Pinus patula*	Roadsides, riparian zones; acidifies soils, creates dense litter
Lantana	*Lantana camara*	Roadsides, unmanaged areas; forms dense thickets, reduces visibility
Triffid Weed	*Chromolaena odorata*	Roadsides, riparian, wetlands; dense stands exclude natives
Guava	*Psidium guajava*	Riparian, marsh margins; thickets block flow, alter sediment
Bugweed	*Solanum mauritianum*	Roadsides, riparian; forms monocultures, displaces indigenous flora
Peanut Butter Cassia	*Senna didymobotrya*	Marsh margins, wetlands; crowds out sedges, native grasses
Black Wattle	*Vachellia mearnsii*	Wetlands, open spaces; absorbs water, ecosystem disruption
Mauritius Thorn	*Caesalpinia decapetala*	Roadsides, urban edges; forms dense stands, thorny barriers
Mexican Sunflower	*Tithonia rotundifolia*	Roadsides, disturbed ground; rapid spread, dominates herbaceous layer
Tecoma	*Tecoma stans*	Riparian, urban fringes; dense undergrowth blocks native regrowth
Syringa	*Melia azedarach*	Roadsides, woodland edges; persistent, outcompetes natives

These species have expanded significantly over the past 15 years, with *Eucalyptus* and *Pinus* establishing mature seed banks, while emerging invasives like *Tithonia rotundifolia* (Mexican Sunflower) spread rapidly through food aid pathways. The Municipal Public Health and Environment Department engaged in the cutting of the Mexican sunflower and other IAPs to control and manage their aggressive spread and impacts. Figure 21 shows some of the invasive plants found in Ezulwini.

Figure 21: Invasive plants present in Ezulwini (Lantana Camara, Eucalyptus, Bugweed, Solanum mauritianum) (Options, 2025)

3.3.1.2 Land Use Transformation

Rapid urbanization represents a fundamental challenge to biodiversity conservation, with Ezulwini serving as Eswatini's fastest growing Municipality. Land use conversion from pristine environments to built infrastructure has resulted in extensive loss of grasslands and forests, while fragmentation limits wildlife movement and degrades ecosystem health. The conversion process involves direct habitat loss, degradation of natural system functioning, and fragmentation that isolates vegetation types.

3.3.1.3 Climate Change Impacts

Climate change compounds existing pressures through multiple pathways, including temperature increases that promote invasive plant proliferation in grassland ecosystems. Elevated CO_2 levels accelerate bush encroachment by species such as *Acacia* spp. and *Dichrostachys cinerea*, while reducing climate resilience agents like

indigenous trees, grasslands, and wetlands. The challenge is further complicated by altered precipitation patterns and increased pathogen pressure.

3.3.2 Secondary Stressors

3.3.2.1 Infrastructure Development

Road construction and urban expansion create additional fragmentation pressures while serving as corridors for invasive species dispersal. Drainage projects and infrastructure development alter natural hydrological patterns, affecting wetland ecosystems and riparian habitats.

3.3.2.2 Resource Extraction

Unsustainable harvesting of medicinal plants and timber species contributes to habitat degradation and species decline. The informal use of natural resources, particularly around culturally significant sites like hot springs, creates management conflicts and environmental contamination.

3.4 Impacts on Biodiversity

3.4.1 Negative Impacts

3.4.1.1 Ecosystem Degradation

Invasive alien plants reduce ecosystem productivity by altering chemical composition of water resources, reducing available water, and clogging waterways. Species like *Chromolaena*, *Vachellia*, *Pinus*, and *Eucalyptus* significantly reduce river flows and groundwater by absorbing large amounts of water. Dense invasive thickets restrict water flow and alter sediment deposition, exacerbating flood risk downstream.

3.4.1.2 Biodiversity Loss

Competitive exclusion affects endemic wetland specialists, with invasive species outcompeting native *Cyperus* spp. and other indigenous flora. The loss of nectar sources for native pollinators occurs when mass-flowering invasives dominate landscapes, while toxic species like *Pinus* prevent understory vegetation establishment.

3.4.1.3 Habitat Fragmentation

Urbanization isolates core habitats, blocking wildlife corridors essential for species like leopard and grey rhebok. Edge effects increase vulnerability to invasive species colonization and fire risk, while reducing overall ecosystem functionality.

3.4.1.4 Socioeconomic Costs

Invasive plants reduce access to grazing areas for livestock, forcing animals to graze within town lawns and reducing pasture quality. Annual management budget exceeds E900,000 for sustainable control across 374 hectares, while infrastructure damage from blocked drainage increases flood and erosion risk.

3.4.2 Positive Impacts

3.4.2.1 Conservation Success Stories

The maintenance of 42% of municipal area under conservation management through Mantenga Nature Reserve demonstrates successful habitat protection. The proximity to Mlilwane Wildlife Sanctuary enhances landscape connectivity and provides refuge for wildlife species.

3.4.2.2 Community Engagement

Innovative community-based initiatives, including PELUM's Eco-garden and conservation farming practices, showcase successful integration of biodiversity conservation with livelihood development. Youth and women's cooperatives have developed utilization programs that convert invasive biomass into organic fertilizer and marketable products.

3.4.2.3 Ecosystem Services Maintenance

Despite pressures, key ecosystem services continue to function, including water regulation through wetland systems, soil stabilization through remaining grasslands, and carbon sequestration through forest conservation.

3.5 Current Responses

3.5.1 Policy and Governance

3.5.1.1 Multilateral Environmental Agreements

The Government of Eswatini has ratified and domesticated key international agreements including the Convention on Biological Diversity (CBD), UN Framework Convention on Climate Change (UNFCCC), and Convention to Combat Desertification (CCD). These translate into national action plans monitored through consultative reports, with municipalities serving as delegated implementers.

3.5.1.2 Municipal Integration

Ezulwini Municipality has integrated Sustainable Development Goals into departmental strategies, with each department aligning with relevant SDG targets. The Municipality maintains an environmental health department that responds to environmental safety issues and waste management challenges.

3.5.2 Active Management

3.5.2.1 Invasive Species Control

The Municipality enforces management of all owned plots to minimize invasive species spread and reduce seed banks. The comprehensive Invasive Alien Plant Species (IAPs) Management Plan implements Early Detection and Rapid Response (EDRR) protocols along transportation corridors. Management approaches include mechanical control through cutting and grinding, chemical control via targeted herbicide application, and innovative utilization programs.

3.5.2.2 Habitat Conservation

Active management of wetlands, grasslands, forests, and open spaces with indigenous trees contributes to climate change mitigation and resilience building. The Mantenga Nature Reserve serves as a critical refuge for wildlife and conserves representative portions of all three ecosystems.

3.5.3 Community Initiatives

3.5.3.1 Conservation Programs

Community-led initiatives include development and maintenance of open areas and parks serving as conservation zones. The PELUM Eco-garden showcases best practices in conservation farming, recycling, composting, and climate resilience development.

3.5.3.2 Utilization Programs

Innovative "use-to-manage" approaches transform invasive species into livelihood opportunities through green manure production, briquette manufacturing, handicraft development, and bee-keeping initiatives. These programs engage youth and women's cooperatives in both conservation and economic development.

3.6 Critical Gaps

3.6.1 Strategic Planning Deficits

3.6.1.1 Lack of Integrated Assessment

The absence of a Strategic Environmental Assessment (SEA) for urban expansion plans represents a critical gap in sustainable development planning. This deficit leads to uncoordinated habitat fragmentation and missed opportunities for biodiversity mainstreaming.

3.6.1.2 Limited Invasive Species Management

Less than 10% of invaded areas receive active management due to resource constraints and limited municipal capacity. Deep seed banks of invasive plants continue to develop in unmanaged areas, resulting in uncontrolled invasion of pristine habitats.

3.6.1.3 Limited Information on Biodiversity

The current state of biodiversity documentation within the Ezulwini Urban Boundary reveals significant knowledge gaps that impede comprehensive environmental planning and conservation efforts. Despite the municipality's recognized ecological importance, no systematic biodiversity inventory has been conducted to catalogue the full range of flora and fauna within the urban boundary. The available biodiversity information consists of fragmented observations gathered from disparate sources rather than a coordinated scientific assessment.

3.6.2 Resource and Capacity Limitations

3.6.2.1 Funding Shortfalls

The annual funding deficit of approximately E900,000 for comprehensive invasive species control represents a substantial barrier to effective management. No dedicated budget exists for habitat restoration or advanced conservation techniques.

3.6.3 Technical Expertise Gaps

Municipal teams lack training in advanced conservation methods, including ecological restoration, climate-resilient species selection, and integrated pest management. Limited capacity exists for systematic monitoring and adaptive management approaches.

3.6.4 Institutional Challenges

3.6.4.1 Governance Conflicts

Differences between formalized and informal use of natural resources, particularly around hot springs, create management conflicts and environmental contamination. Weak enforcement of environmental regulations leads to continued degradation of sensitive habitats.

3.6.5 Coordination Deficits

Fragmented approaches to conservation and development limit the effectiveness of biodiversity management efforts. Poor integration between invasive species control and broader ecosystem restoration reduces overall conservation impact.

3.7 Recommendations

3.7.1 Strategic Interventions

3.7.1.1 Conduct Comprehensive Biodiversity Mapping and Action Plan

Conduct an inventory of biodiversity assets in Ezulwini and implement a Municipality-wide Biodiversity Action Plan that maps critical habitats as "no-build zones" and establishes targets for reducing invasive species cover by 50% by 2030. Integrate biodiversity metrics into urban planning processes and prioritize connectivity between conservation areas.

3.7.1.2 Conduct Strategic Environmental Assessment

Undertake a comprehensive SEA for urban development plans to ensure biodiversity mainstreaming from the planning phase. Establish clear protocols for development impact assessment and mitigation.

3.7.2 Ecosystem-Based Management

3.7.2.1 Habitat Corridor Restoration

Establish wildlife corridors connecting Mantenga Nature Reserve with Mlilwane Wildlife Sanctuary through strategic habitat restoration. Plant indigenous buffer species along riparian zones and install wildlife crossings on fragmenting roads.

3.7.2.2 Integrated Invasive Species Management

Implement phased eradication programs prioritizing watershed-critical areas such as Lusushwana River banks. Combine mechanical removal with targeted herbicide treatment and introduce biological control agents where appropriate.

3.7.3 Community Engagement and Capacity Building

3.7.3.1 Scale Utilization Programs

Expand community-based utilization initiatives by establishing cooperatives for invasive-based product development. Create certified value chains for products including briquettes, organic fertilizer, handicrafts, and honey.

3.3.3.2 Technical Training Programs

Partner with the Eswatini National Trust Commission to provide comprehensive training in invasive species identification, safe herbicide application, and habitat restoration techniques. Develop community certification programs for sustainable resource utilization.

3.7.4 Governance and Funding

3.7.4.1 Establish Dedicated Conservation Fund

Allocate 5% of municipal tourism revenue to biodiversity conservation projects, creating sustainable funding for long-term management. Explore innovative financing mechanisms including payment for ecosystem services.

3.7.5 Strengthen Institutional Coordination

Create stakeholder forums for natural resource management, particularly around culturally significant sites. Establish clear protocols for environmental compliance monitoring and enforcement.

3.7.6 Monitoring and Adaptive Management

3.7.6.1 Implement Digital Monitoring Systems

Deploy GPS-tagged surveys to track invasive species spread and treatment efficacy. Establish standardized monitoring protocols for ecosystem health and species population trends.

3.7.6.2 Research and Development

Conduct impact studies to quantify ecosystem service trade-offs and inform adaptive management decisions. Develop local capacity for ecological research and monitoring.

3.8 Conclusion

Ezulwini Municipality represents a microcosm of global biodiversity challenges, where high conservation value coexists with intense development pressure and invasive species threats. The Municipality's success in maintaining 42% of its area under conservation management demonstrates the potential for urban biodiversity conservation, while innovative community-based utilization programs offer models for transforming environmental challenges into livelihood opportunities. **The overall state of biodiversity in Ezulwini is declining**, as evidenced by several critical

indicators: invasive alien plant species have expanded significantly over the past 15 years, now covering 374 hectares (22% of municipal land). The near-endemic *Senecio mlilwanensis* remains vulnerable and under review for threatened status, while human-wildlife conflict indicates ecosystem stress. Habitat fragmentation continues to accelerate due to rapid urbanization, limiting wildlife movement and degrading ecosystem health. Climate change compounds these pressures through temperature increases that promote invasive proliferation and alter ecosystem composition.

However, the scale of invasive species infestation, covering 22% of municipal land with high annual management costs, requires urgent and coordinated intervention. The absence of strategic environmental assessment for urban development plans threatens to undermine conservation gains through continued habitat fragmentation. The path forward requires integrated ecosystem-based management that combines targeted invasive species control, habitat restoration, community engagement, and sustainable financing mechanisms. Success depends on addressing critical gaps in strategic planning, technical capacity, and institutional coordination while scaling innovative approaches that demonstrate the compatibility of conservation and development objectives. Ezulwini's biodiversity future hinges on immediate action to implement comprehensive management strategies that address both the symptoms and root causes of ecosystem degradation.

Chapter 4: Freshwater Management

"Water is fundamental to all aspects of life," – United Nations

4.1 Overview

Freshwater management in Ezulwini between 2020 and 2024 has seen **mixed outcomes**. Infrastructure expansion and improved service coverage reflect **positive progress** in water availability and consumption management, yet **stagnant or declining water quality** especially concerning *E. Coli,* turbidity, and fluoride exceedances poses persistent public health and environmental risks. Overall, the state of freshwater relies on urgent quality interventions alongside sustained infrastructure and governance improvements.

4.1.1 Background and Context

Ezulwini Municipality, sandwiched between Mbabane and Manzini in Eswatini's Ezulwini Valley, was established as a Town Council in 1995 and upgraded to a Town Council in 2012 under the Urban Government Act 1969 Its water supply stems primarily from three sources i.e. Mkhondolwane, Ecansini, Mdzimba springs, and Woodland's boreholes managed by Eswatini Water Services Corporation (EWSC) under the Water Act 2003. National policies like Water Act 2003, Environmental Management Act 2002, and Health Act 2023 define standards, while international frameworks like WHO Drinking Water Guidelines and SDG 6 (Ensure availability and sustainable management of water and sanitation for all) guide quality, safety, and ecosystem resilience. Ezulwini's Integrated Development Plan (IDP 2019–2049) and emerging Bylaws aim to localize these mandates for resource protection and service delivery.

4.2 State of Freshwater Management

4.2.1 Available Water Sources

4.2.1.1 Primary Water Sources

Ezulwini's water supply system relies on three main sources, as confirmed by the Eswatini Water Services Corporation (EWSC). The Makhondolwane, Ecansini source, located in the Zeeman's area within the Ezulwini community, serves as a primary water source under EWSC protection. The Mdzimba source, also within the Ezulwini community, provides regular water supply but is shared with the local community, creating potential contamination risks. The Woodlands source in Mbabane serves as a supplementary water source during dry seasons, providing additional security to the water supply system. Abstraction quotas and extraction permits are enforced by the Ministry of Natural Resources, aligning with Eswatini's Water Act 2003. Sustainable abstraction and source protection are consistent with global best practices for ecosystem and community water security. The Ezulwini valley contains several headwater and riparian wetlands along the Mkhondolwane and Lusushwane rivers (Figure 22)

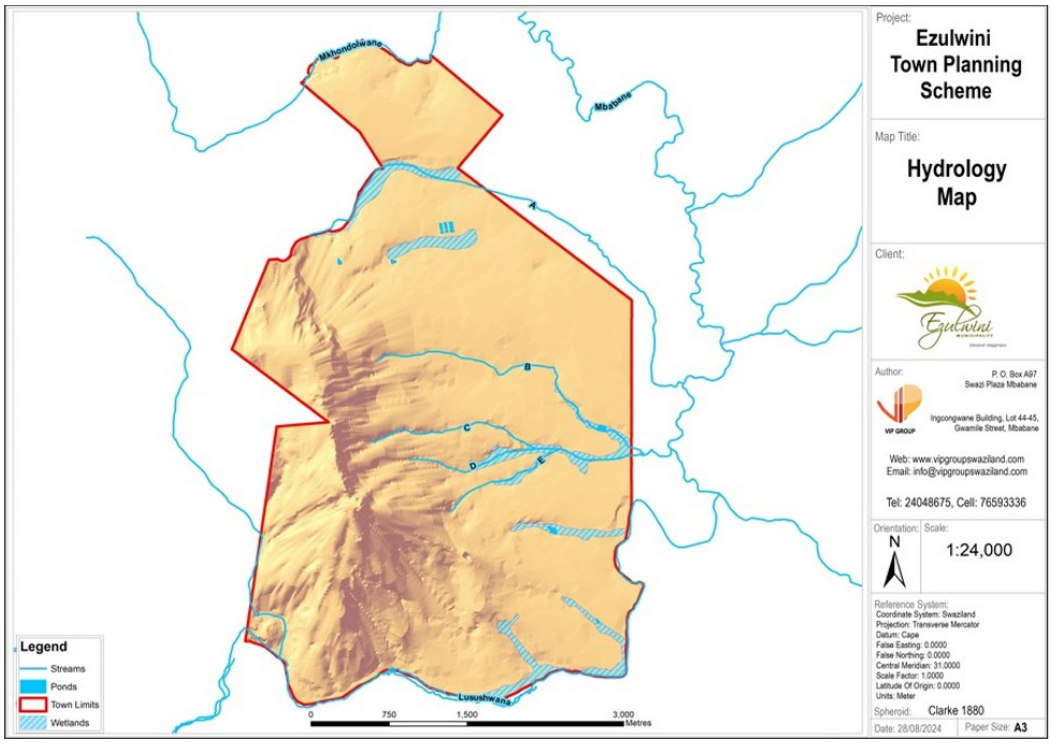

Figure 21: Ezulwini Hydrology Map (Ezulwini Municipality, 2024)

4.2.2 Wetland Conservation

Ezulwini contains several important wetland ecosystems that form critical components of the local environment. These wetlands serve as essential ecological features, providing numerous ecosystem services while facing various pressures from development, climate change, and human activities. Figure 21 show maps of wetlands and river systems with 33m buffer zones in Ezulwini.

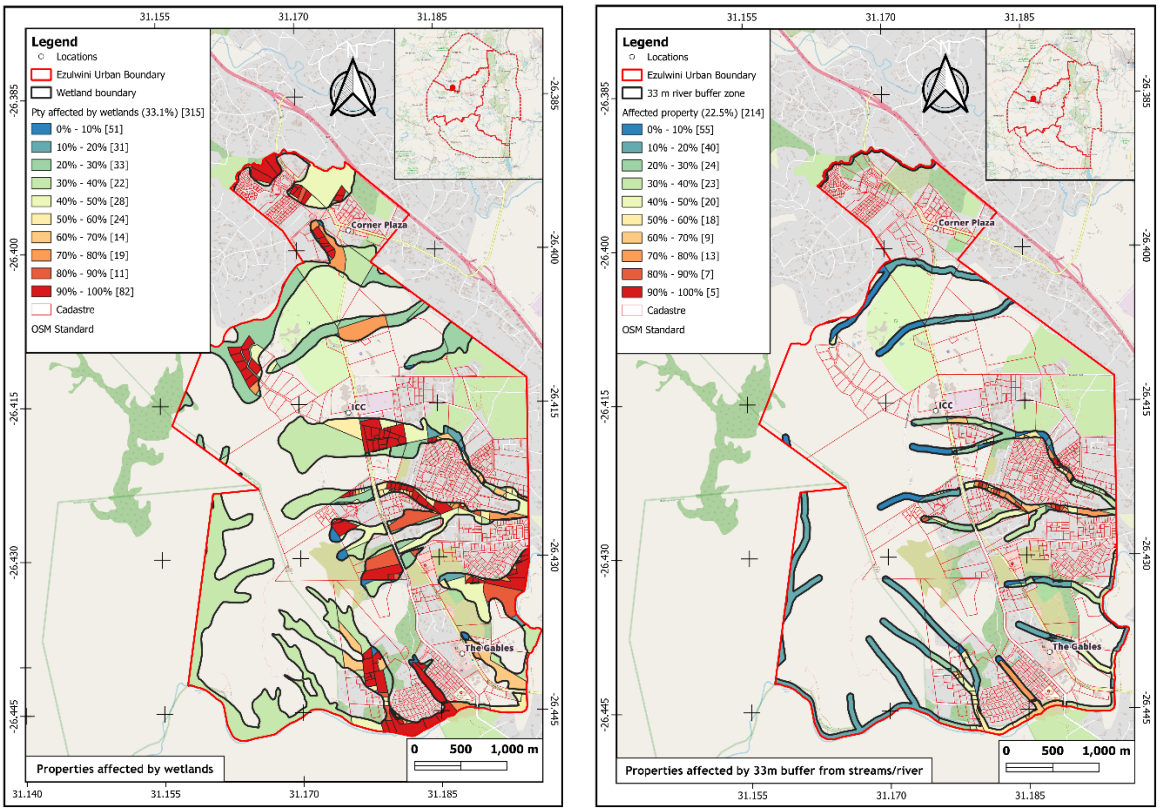

Figure 20: Maps showing Wetlands and 33m Buffer Zones in Ezulwini

The wetland and river systems within the Ezulwini Urban Boundary represent a complex network of several wetland locations, including the primary Mkhondolwane River and numerous tributary streams, which collectively provide critical flood protection and ecosystem services while significantly constraining urban development. The field assessment revealed that 22.5% of properties (214 properties) are affected by mandatory 33-meter river buffer zones, while an even larger proportion, 33.1% of properties (315 properties) fall within wetland protection areas, with 82 properties experiencing 90-100% coverage by wetland buffers. These natural systems function as essential flood management infrastructure by storing excess water during heavy rainfall, regulating flow rates, and preventing downstream flooding, but face increasing pressure from urbanization which threatens to eliminate their protective capacity and significantly increase flood risks for the entire municipality.

The spatial analysis demonstrates that properties within buffer zones face severe development restrictions, reduced land values, and regulatory constraints that limit construction to elevated structures and essential infrastructure only, creating a critical balance between environmental protection and urban development needs. Without strict enforcement of these buffer zones and integration of green infrastructure approaches, Ezulwini faces escalating flood vulnerabilities as urban growth continues to generate impervious surfaces that can increase surface runoff, potentially overwhelming existing drainage systems and exposing the community to catastrophic flooding events during extreme weather periods intensified by climate change. Figure 22 shows pictures of some of the rivers and wetlands in Ezulwini.

Figure 22: River systems and wetlands in Ezulwini

4.2.3 Infrastructure Development

The African Development Bank funded Ezulwini Sustainable Water Supply and Sanitation Project have been the cornerstone of infrastructure development during this period. Construction commenced in June 2014 and involved the development of a 15ML reservoir, gravity pipeline, and 12 water kiosks to serve areas not covered by the distribution system.

4.2.4 Water Quality Analysis

Water quality monitoring data from 2019 to 2024 reveals concerning bacterial contamination levels across all major water sources. E.coli levels consistently exceed the Water Act 2003 standard of 1-10 per 100ml in all monitored freshwater sources, indicating ongoing faecal contamination issues. The Cuddle Puddle source shows the most severe contamination, with E. coli levels ranging from 959 per 100ml in 2021/2022 to a peak of 6,179 per 100ml in 2023/24. The Mkhondolwane source demonstrated both the highest contamination level recorded (19,240 per 100ml in 2020/2021) and the most significant improvement, dropping to 62 per 100ml by 2024. Lusushwane source maintains relatively stable but elevated contamination levels, ranging from 51 to 171 per 100ml throughout the monitoring period. pH levels across all water sources generally comply with the Water Act 2003 standards of 6.5-

8.5, showing gradual improvement over the monitoring period. Turbidity measurements consistently exceed the standard of 5 Nephelometric units maximum, particularly during rainy seasons, indicating ongoing issues with water clarity and suspended solids. Fluoride levels at Cuddle Puddle sources significantly exceed the 1.0 mg/L maximum standard, reaching up to 6.3 mg/L in some measurements, attributed to natural fluoride-containing minerals in the area.

4.2.4.1 Parameters that exceed Acceptable Standards

Below are the trends for the three main water quality parameters which are out of specification including Turbidity, E. coli, and Fluoride in Ezulwini's key water sources from 2020 to 2024. All data are sourced from municipal water analysis records and are compared against the Eswatini Water Act 2003 standards.

Turbidity Trends (2020–2024)

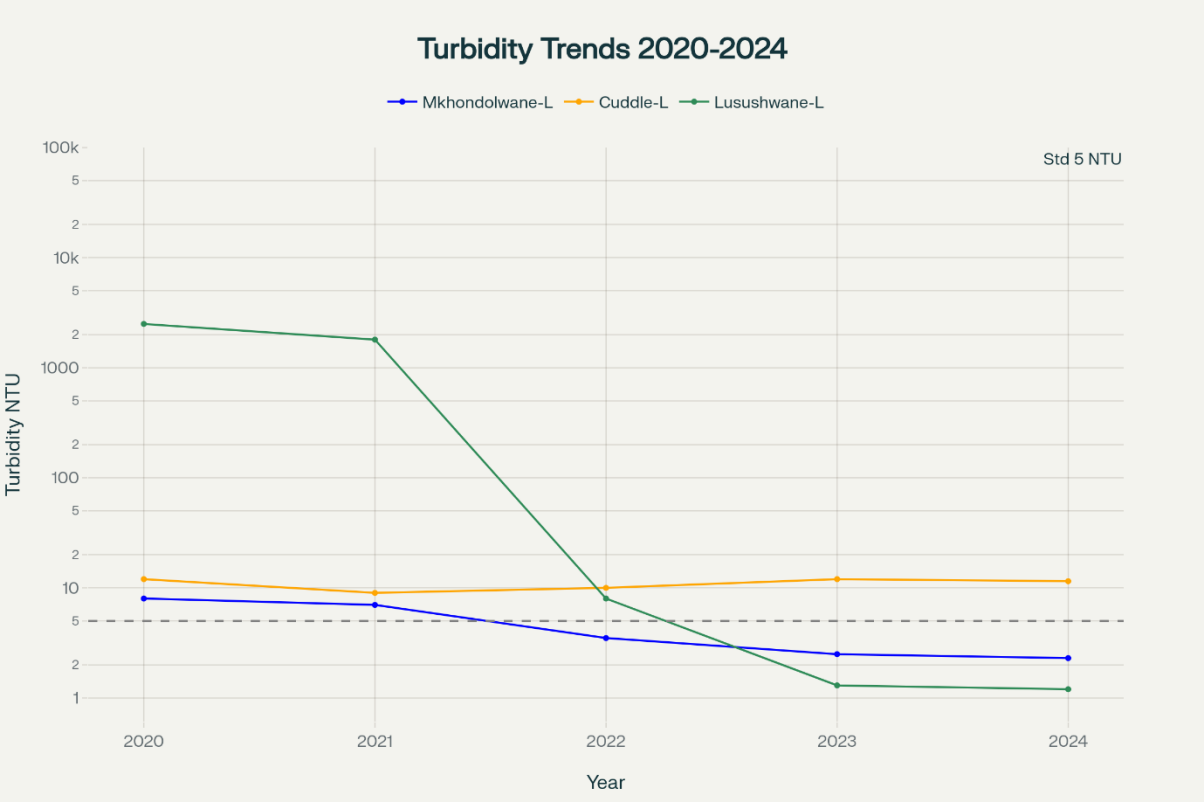

Figure 23: Turbidity trends (2020-2024) for key Ezulwini water sources, with standard threshold indicated

Key Insights include:

a) Mkhondolwane (Lower)

- Turbidity levels started high in 2020 (12.9 NTU) but have steadily declined each year.
- By 2024, the value dropped to 2.5 NTU, now consistently below the 5 NTU standard.

- This trend indicates significant improvement in water clarity and reduction of suspended solids over time.

b) Cuddle Puddle (Lower)

- Turbidity has remained persistently above the standard in most years, peaking at 13.8 NTU in 2023 and remaining high at 12.7 NTU in 2024.
- These values are more than double the acceptable limit, highlighting ongoing issues with water clarity and possible pollution sources.

c) Lusushwane (Lower)

- Extremely high turbidity was recorded in 2020 (3391 NTU) and 2021 (1859.5 NTU), likely due to unusual events or severe runoff.
- From 2022 onward, turbidity dropped dramatically, reaching 2.6 NTU in 2024, well below the standard.
- The sharp decline suggests effective interventions or changes in environmental conditions.

Interpretation

- Improvement: Mkhondolwane (Lower) and Lusushwane (Lower) have shown marked improvement, with 2024 values now compliant with national standards.
- Persistent Challenge: Cuddle Puddle (Lower) remains a concern, with turbidity consistently above safe levels, indicating the need for targeted management and source protection.
- Health Implications: Elevated turbidity can shield pathogens from disinfection, increasing public health risks. Continued monitoring and intervention are essential, especially for Cuddle Puddle (Lower).

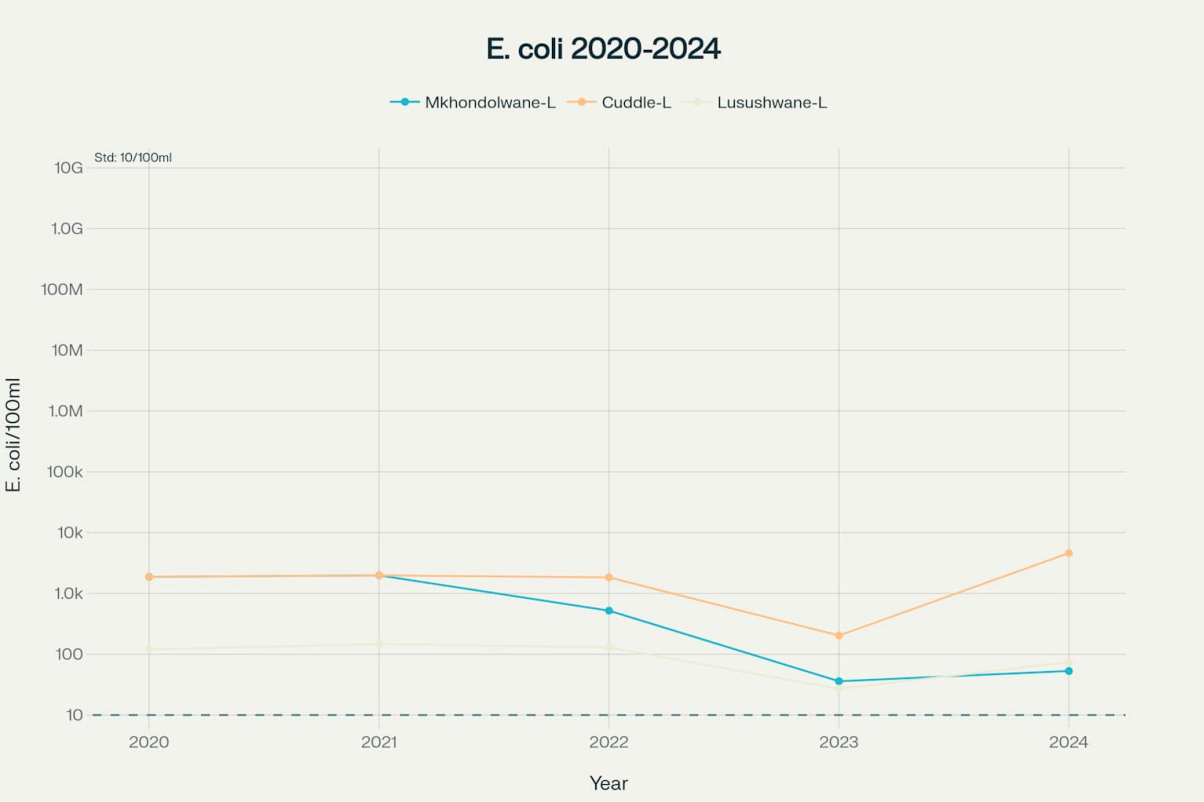

Figure 24: E. coli trends (2020-2024) for key Ezulwini water sources, with standard threshold indicated

Key Insights include

a) Mkhondolwane (Lower)

- E. coli levels started extremely high in 2020 (1,872 per 100ml), showing a significant decline to 53 per 100ml in 2024.
- Despite the improvement, values remain above the national standard, indicating ongoing contamination risks.

b) Cuddle Puddle (Lower)

- E. coli contamination is persistently severe, with levels fluctuating and peaking at 4,611 per 100ml in 2024.
- This source consistently exceeds the safe limit by several orders of magnitude, highlighting chronic faecal contamination.

c) Lusushwane (Lower)

- E. coli levels are lower compared to the other two sources but remain above the standard throughout the period (ranging from 27 to 148 per 100ml).
- This indicates persistent, though less severe, contamination.

Interpretation

- All sources exceed the safe E. coli limit (10 per 100ml) every year, posing a continuous public health concern.
- Cuddle Puddle (Lower) is the most problematic, requiring urgent intervention.
- Mkhondolwane (Lower) shows improvement but still needs further action to reach compliance.
- Lusushwane (Lower) maintains moderate but unacceptable levels.

Fluoride Trends (2020–2024)

The graph below illustrates fluoride concentrations (mg/L) in key Ezulwini water sources—Mkhondolwane (Lower), Cuddle Puddle (Lower), and Lusushwane (Lower)—from 2020 to 2024. The Water Pollution standard for fluoride is 1.0 mg/L.

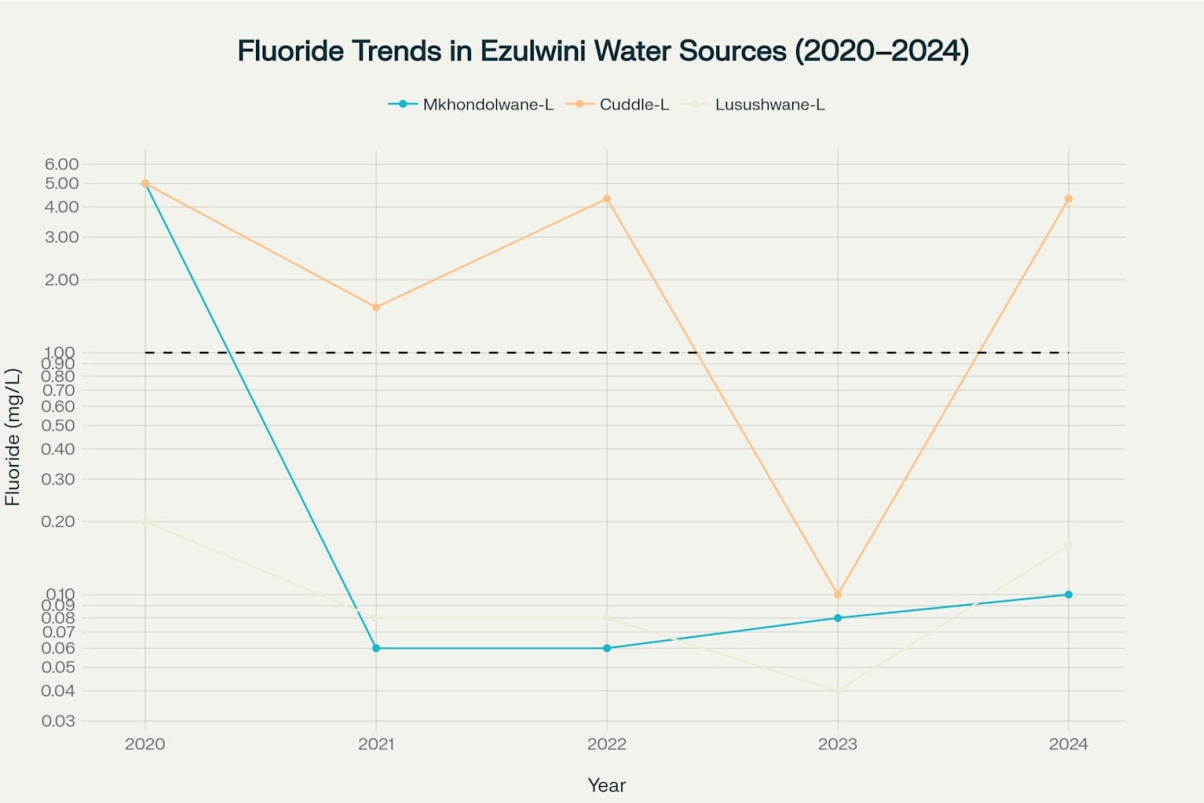

Figure 25: Fluoride concentrations (mg/L) in Mkhondolwane-L, Cuddle-L, and Lusushwane-L from 2020 to 2024, with the 1.0 mg/L standard indicated

Interpretation

- Cuddle Puddle (Lower): Fluoride levels are consistently and significantly above the national standard, with values ranging from 4.33 mg/L to as high as 6.3 mg/L in certain years. This chronic exceedance is attributed to the local geology, where natural minerals leach fluoride into the water supply.
- Mkhondolwane (Lower) and Lusushwane (Lower): Both sources have maintained fluoride concentrations well below the 1.0 mg/L standard

throughout the period. No significant risk from fluoride is observed in these sources.

Key Insights include:

- Health Risk: Only Cuddle Puddle (Lower) poses a chronic fluoride risk, which can lead to dental and skeletal fluorosis for consumers if untreated water is used for drinking over long periods.
- Compliance: Mkhondolwane (Lower) and Lusushwane (Lower) remain compliant with national standards, indicating effective natural filtration or absence of fluoride-rich geological formations in their catchments.
- Management Implications: Targeted interventions such as defluorination or alternative water sourcing is required for Cuddle Puddle (Lower), while continued monitoring is recommended for all sources.

Key Takeaways include:

- Turbidity: Significant improvement in some sources but Cuddle Puddle (Lower) remains problematic.
- E. coli: All sources exceed safe limits, with Cuddle Puddle (Lower) showing the most severe and persistent contamination.
- Fluoride: Only Cuddle Puddle (Lower) poses a chronic risk, requiring targeted intervention.

4.2.5 Comparative Source Analysis

- Cuddle Puddle sources are the most problematic, with all three parameters frequently exceeding standards, especially E. coli and turbidity.
- Mkhondolwane and Lusushwane sources show lower, but still non-compliant, E. coli and turbidity levels, with occasional fluoride exceedance.
- The graph visually highlights that no source fully complies with all water quality standards, emphasizing systemic water quality challenges.

4.2.6 Implications

- Public Health: The high E. coli and turbidity levels indicate a persistent risk of waterborne diseases for users of these sources.
- Regulatory Compliance: All sources fail to meet at least one of the national standards, necessitating urgent remedial action.
- Source-Specific Risks: Cuddle Puddle sources require the most urgent intervention due to multiple parameter violations.

4.3 Water Consumption Trends

4.3.1 Consumption Patterns

Water consumption has been increasing in Ezulwini due to the rapid urbanization. Figure 26 presents the monthly water consumption by Ezulwini Municipality as supplied by the Eswatini Water Services Corporation (EWSC) from April 2024 to February 2025. The data reflects the Municipality's ongoing demand for water resources over an 11-month period.

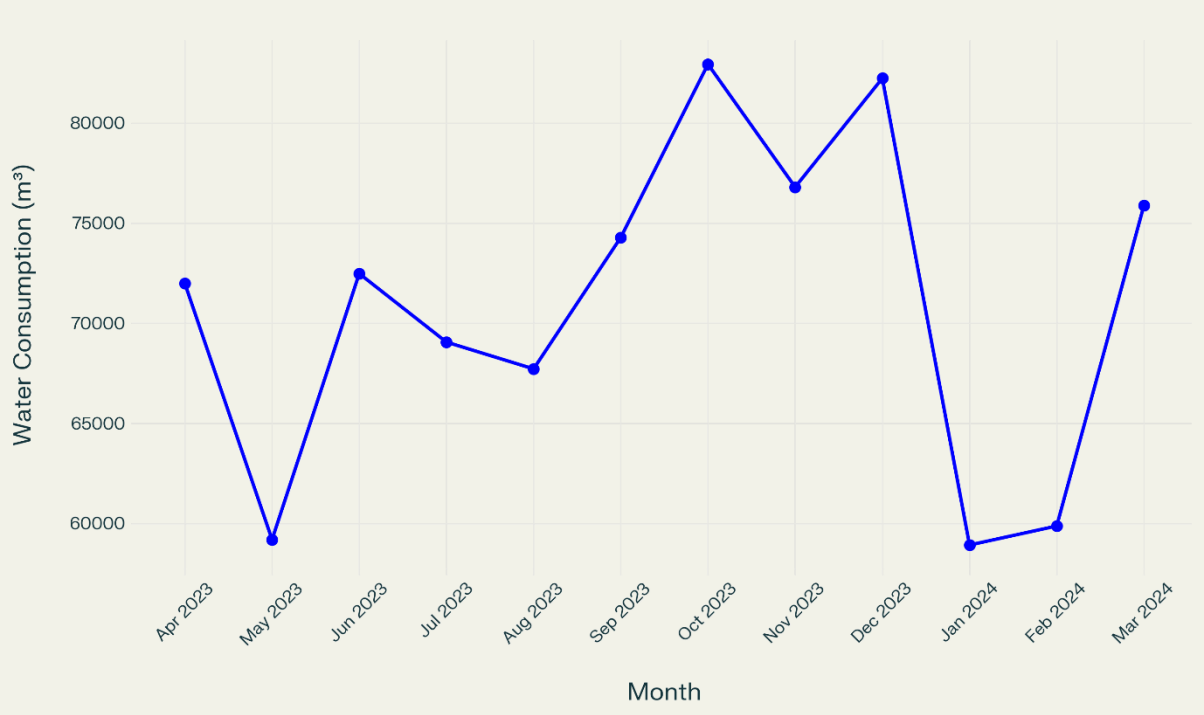

Figure 26: Monthly EWSC Water Consumption by Ezulwini Municipality (April 2024 – February 2025)

- The graph shows notable fluctuations in monthly treated water consumption, with values generally ranging between 59,000 m³ and 83,000 m³. Peaks are observed in October and December 2023, while significant drops occur in May 2023 and January–February 2024. This pattern suggests seasonal variation, possibly influenced by rainfall, tourism, or operational factors.
- Fluctuations: The data shows notable fluctuations, with consumption generally rising from April, peaking in December, and then dropping in January before a slight increase in February.
- Overall Pattern: The trend suggests higher water demand during the warmer and festive months.

Key Insights include:

- Seasonal Variation: Water use increases in the second half of the year, peaking in December, which may be attributed to both climatic conditions and population activity.

- Planning Implications: The observed trend highlights the need for robust water supply planning, especially for peak months, to ensure consistent service delivery and resource sustainability.

EWSC reported that the number of water connections grew from approximately 1,800 in 2019 to 2,134 connections by 2024, indicating improved service coverage.

4.3.2 Infrastructure Pressures

Development projects in the area, including the International Convention Centre (ICC) and Five Star Hotel (FISH), have increased water demand pressures. Key customers such as parastatals headquarters and major commercial developments contribute to rising consumption patterns. The new 15ML reservoir at Mantenga provides 4-5 days of supply capability without extraction, improving system resilience.

4.3.3 Water Source Protection Measures

4.3.3.1 Physical Protection Systems

EWSC has implemented comprehensive protection measures including fencing around water sources to prevent access from community members, wild animals, and livestock. The Ecansini water source benefits from enhanced protection as it is located within the Mlilwane Game Reserve, while the Mdzimba source requires ongoing management due to shared community access. Water extraction permits from the Ministry of Natural Resources ensure regulated abstraction from all sources.

4.3.4 Technological Interventions

The Municipality has deployed advanced monitoring systems including sensory equipment called Minimum Night Flows that send alerts when leaks are detected in the distribution system. A prepaid water meter project has been implemented to promote water conservation and reduce consumption. Smart meter technology and customer education programs support demand management initiatives.

4.3.5 Conservation Initiatives

EWSC conducts regular customer clinics to engage communities on water conservation practices. Social media awareness campaigns promote responsible water use among residents and businesses. The planned integration of Lobamba and Ezulwini water supply systems aims to improve overall system efficiency and protection.

4.4 Pressures, Driving Forces, and Impacts on Freshwater in Ezulwini

4.4.1 Driving Forces

4.4.1.1 Urbanization and Population Growth

- Ezulwini has experienced rapid population growth, with projections reaching around 2,800 people in 2024, and significant expansion in residential and commercial developments.
- Urbanization has led to increased demand for water supply, sanitation services, and infrastructure, with water connections rising from 1,800 in 2019 to 2,134 in 2024.

4.4.1.2 Economic Development

- Major infrastructure projects, such as the International Convention Centre (ICC), Five Star Hotel (FISH), and new commercial centres, have heightened water demand and resource pressures.
- Growth in tourism, hospitality, and retail sectors has intensified water use and waste generation, impacting water quality and management.

4.4.1.3 Policy and Regulatory Framework

- The Municipality relies on national legislation, including but not limited to the Urban Government Act (1969), Public Health Act (1969), and Environmental Management Act (2002), and the Water Act 2003 to guide freshwater management.
- Local Bylaws are being developed to address gaps in national regulations, particularly for environmental management and water source protection.

4.4.2 Pressures on Freshwater Resources

4.4.2.1 Water Quality Degradation

- Persistent bacterial contamination (E. coli and total coliforms) in all major water sources, with levels exceeding national standards by orders of magnitude, mainly due to human and animal activities near rivers and springs.
- Chronic turbidity violations, especially in Cuddle Puddle sources, are linked to runoff, erosion, and inadequate catchment protection.
- Elevated fluoride concentrations in certain springs (notably Cuddle Puddle-Lower and Cuddle Puddle-Middle) are attributed to local geology, posing long-term health risks.

4.4.2.2 Increased Water Consumption

- Daily water consumption has grown from 3.5 ML/day in 2019 to 4.0 ML/day in 2024, driven by urban expansion, population growth, and commercial development.
- Seasonal and festive peaks, particularly in December, put additional strain on water supply systems.

4.4.2.3 Wastewater and Pollution

- Wastewater from Ezulwini is treated offsite in Matsapha, with effluent tested before environmental discharge, but the lack of local treatment capacity poses risks in case of system failures.

4.4.2.4 Land Use and Catchment Changes

- Expansion of residential and commercial developments has reduced natural buffers and increased impervious surfaces, exacerbating runoff and pollution risks.

- Encroachment on riparian zones and insufficient enforcement of land use regulations contribute to water source vulnerability.

4.4.2.5 Climate Variability

- Seasonal fluctuations in rainfall and flow, with lower flows in winter, affect water availability and quality, especially in unprotected or shared sources.
- Increased frequency of extreme weather events (e.g., floods, droughts) poses additional risks to water infrastructure and quality.

4.4.3 Impacts on Freshwater and Community

4.4.3.1 Public Health Risks

- High levels of E. coli and turbidity in drinking water sources present ongoing risks of waterborne diseases, including diarrhoea, cholera, and typhoid.
- Chronic fluoride exposure in some springs may lead to dental and skeletal fluorosis, especially among children.

4.4.3.2 Environmental Degradation

- Degraded water quality affects aquatic ecosystems, reduces biodiversity, and impairs the natural self-purification capacity of rivers and springs.
- Increased sedimentation and nutrient loads from runoff accelerate the degradation of water bodies.

4.4.3.3 Socio-Economic Consequences

- Poor water quality undermines the tourism sector, a key economic driver for Ezulwini, and increasing costs for water treatment and public health interventions.
- Rising water demand and periodic shortages can disrupt commercial activities and reduce quality of life for residents.

4.4.3.4 Infrastructure Strain

- Increased consumption and pollution place additional strain on existing water supply, storage, and distribution infrastructure, necessitating ongoing investment and upgrades.
- Limited laboratory and rapid response capacity hinder effective real-time water quality monitoring and management.

4.4.4 Driving Forces

4.4.4.1 Urbanization and Population Growth

- Ezulwini has experienced rapid population growth, with projections reaching around 2,800 people in 2024, and significant expansion in residential and commercial developments.

- Urbanization has led to increased demand for water supply, sanitation services, and infrastructure, with water connections rising from 1,800 in 2019 to 2,134 in 2024.

4.4.4.2 Economic Development

- Major infrastructure projects, such as the International Convention Centre (ICC), Five Star Hotel (FISH), and new commercial centres, have heightened water demand and resource pressures.
- Growth in tourism, hospitality, corporate and retail sectors has intensified water use and waste generation, impacting water quality and management.

4.4.4.3 Policy and Regulatory Framework

- The Municipality relies on national legislation, including the Urban Government Act, Public Health Act, and Environmental Management Act, to guide freshwater management.
- Municipal Bylaws have been developed to address gaps in national regulations, particularly for waste management and water source protection.

4.4.5 Pressures on Freshwater Resources

4.4.5.1 Water Quality Degradation

- Persistent bacterial contamination (E. coli and Total coliforms) in all major water sources, with levels exceeding national standards by orders of magnitude, mainly due to human and animal activities near rivers and springs.
- Chronic turbidity violations, especially in Cuddle Puddle sources, are linked to runoff, erosion, and inadequate catchment protection.
- Elevated fluoride concentrations in certain springs (notably Cuddle Puddle-L and Cuddle Puddle-M) are attributed to local geology, posing long-term health risks.

4.4.5.2 Increased Water Consumption

- Daily water consumption has grown from 3.5 ML/day in 2019 to 4.0 ML/day in 2024, driven by urban expansion, population growth, and commercial development.
- Seasonal and festive peaks, particularly in December, put additional strain on water supply systems.

4.4.5.3 Wastewater and Pollution

- Wastewater from Ezulwini is treated offsite in Matsapha, with effluent tested before environmental discharge, but the lack of local treatment capacity poses risks in case of system failures.
- Hazardous and healthcare waste is managed through contracted services, but general hazardous waste (e.g., bulbs, paint) often ends up in municipal waste streams due to lack of segregation infrastructure.

4.4.5.4 Land Use and Catchment Changes

- Expansion of residential and commercial developments has reduced natural buffers and increased impervious surfaces, exacerbating runoff and pollution risks.
- Encroachment on riparian zones and insufficient enforcement of land use regulations contribute to water source vulnerability.

4.4.5.5 Climate Variability

- Seasonal fluctuations in rainfall and flow, with lower flows in winter, affect water availability and quality, especially in unprotected or shared sources.
- Increased frequency of extreme weather events (e.g., floods, droughts) poses additional risks to water infrastructure and quality.

4.4.6 Impacts on Freshwater and Community

4.4.6.1 Public Health Risks

- High levels of E. coli and turbidity in drinking water sources present ongoing risks of waterborne diseases, including diarrhoea, cholera, and typhoid.
- Chronic fluoride exposure in some springs may lead to dental and skeletal fluorosis, especially among children.

4.4.6.2 Environmental Degradation

- Physical development activities within wetland ecosystems and their buffer zones represent a primary threat to the ecological integrity and functional capacity of these critical aquatic systems within the Ezulwini Urban Boundary. Direct physical alteration of wetland habitats through construction activities results in irreversible loss of native vegetation communities, disruption of soil structure and hydrological connectivity, and elimination of critical breeding and foraging habitats for wetland-dependent species.
- The conversion of wetland areas for physical development dramatically increases flood vulnerability for the broader Ezulwini community by eliminating the natural flood storage and flow regulation capacity that these ecosystems provide.
- Degraded water quality affects aquatic ecosystems, reduces biodiversity, and impairs the natural self-purification capacity of rivers and springs.
- Increased sedimentation and nutrient loads from runoff accelerate the degradation of water bodies.

4.4.6.3 Socio-Economic Consequences

- Poor water quality undermines the tourism sector, a key economic driver for Ezulwini, and increases costs for water treatment and public health interventions.

- Rising water demand and periodic shortages can disrupt commercial activities and reduce quality of life for residents.

4.4.6.4 Infrastructure Strain

- Increased consumption and pollution place additional strain on existing water supply, storage, and distribution infrastructure, necessitating ongoing investment and upgrades.
- Limited laboratory and rapid response capacity hinder effective real-time water quality monitoring and management.

4.4.7 Summary of Current Responses

4.4.7.1 Water Source Protection

- Fencing and Access Control: Main water sources are fenced to prevent contamination from livestock, wild animals, and unauthorized access.
- Protected Areas: The Ecansini source is within the Mlilwane Game Reserve, providing natural protection.
- Extraction Permits: All abstraction is regulated via permits from the Ministry of Natural Resources.
- Infrastructure Investments: A new 15ML reservoir at Mantenga was completed, reducing over-extraction risks and enhancing supply resilience.

4.4.7.2 Water Quality Management

- Routine Monitoring: Regular testing of physical, chemical, and microbiological parameters, including E. coli, turbidity, and fluoride, is conducted at all main sources.
- Wastewater Management: Ezulwini's wastewater is treated at Matsapha, with effluent tested before environmental discharge.
- Hazardous Waste Control: Healthcare risk waste is managed via contracted services, with regular reporting and compliance monitoring.

4.4.7.3 Demand and Consumption Management

- Prepaid and Smart Metering: Introduction of prepaid meters and smart metering to promote conservation and reduce non-revenue water.
- Public Awareness: Customer clinics, social media campaigns, and community meetings promote water conservation and responsible use.
- Infrastructure Expansion: Water connections increased from 1,800 (2019) to 2,134 (2024), and sewer connections reached 578, improving access and sanitation.

4.4.7.4 Stakeholder Engagement

- Annual General Meetings (AGMs): Regular AGMs and ward meetings for stakeholder input on planning and budgeting.

- Community Programs: Collaboration with local leaders and committees for waste management and environmental awareness.

4.4.8 Critical Gaps in Freshwater Management

4.4.8.1 Limited Information on Wetland Status

- The current understanding of wetland ecosystems within the Ezulwini Urban Boundary is characterized by significant data limitations and incomplete documentation, despite the evident ecological importance of these systems to municipal environmental integrity and flood management capacity.

4.4.8.2 Water Quality Non-Compliance

- Bacteriological Contamination: All main sources consistently exceed national and WHO standards for E. coli, with some readings above 1,000 per 100ml and spikes over 10,000 per 100ml.
- Turbidity Violations: Persistent exceedances of the 5 NTU standard, especially in Cuddle Puddle sources, indicate ongoing issues with suspended solids and pathogen risk.
- Fluoride Exceedance: Chronic fluoride levels above 1.0 mg/L in Cuddle Puddle sources, linked to local geology, pose long-term health risks.

4.4.8.2 Limited Laboratory and Monitoring Capacity

No municipal laboratory exists in Ezulwini. Routine testing of water, wastewater and food samples relies on external facilities, typically the Eswatini Water Services Corporation and Manzini City Council laboratories.

- Turnaround Time: Sample analysis requires 2–3 weeks, delaying interventions in cases of contamination or public health risk.
- Impact: The absence of in-town testing hampers rapid response to water-related incidents and prolongs regulatory enforcement under the Water Act, 2003 requirements.

4.4.8.3 Inadequate Hazardous Waste Segregation

- General Waste Mixing: Hazardous waste (e.g., bulbs, paint) often ends up in municipal waste streams resulting in contamination of surface and ground water through runoff and leachate. Subsequently, such toxicity leads to harm to aquatic ecosystems through eutrophication and contamination of water sources with long-term chronic health risks.

4.4.8.4 Infrastructure and Budgetary Limitations

- Budget Constraints: Limited funds restrict proactive interventions, laboratory investments, and expansion of monitoring systems.
- Aging/Insufficient Infrastructure: A few houses use septic tank systems which potentially affect groundwater quality.

4.4.8.5 Policy and Regulatory Gaps

- Delayed Bylaws Gazetting: Local Bylaws for waste and environmental management are still pending gazetting, limiting enforcement capacity.
- Limited Mainstreaming of Vulnerable Groups: Environmental planning has not fully targeted vulnerable populations (women, youth, disabled) for inclusive service delivery.

4.4.8.6 Cross-Boundary and Peri-Urban Challenges

- Illegal Dumping: Waste from surrounding peri-urban areas is often dumped in Ezulwini due to lack of infrastructure outside municipal boundaries.
- Shared Water Sources: Some sources (e.g., Mdzimba) are shared with communities, increasing risk of contamination and complicating protection efforts.

4.4.9 Recommendations

4.4.9.1 Strict enforcement of development restrictions within wetland buffer zones

- This represents an essential municipal responsibility. The current regulatory framework protecting 33.1% of properties through wetland buffers must be rigorously maintained to prevent irreversible ecological degradation and catastrophic increases in community flood vulnerability.

4.4.9.2 Conduct a Wetland Inventory and Action Plan

- This will provide a structured framework for documenting, protecting, and managing the extensive wetland systems within Ezulwini Urban Boundary.
- The action plan for managing wetland should include a proposal for a legal framework to preserve wetlands within private properties with a compensation framework.

4.4.9.3 Water Quality Improvement

- Expand Laboratory Capacity: Establish a municipal laboratory for real-time water and food safety testing to enable proactive management.
- Increase Monitoring Frequency: Implement continuous, automated monitoring of key parameters (E. coli, turbidity, fluoride) at all intake points.

4.4.9.4 Strengthen Source Protection

- Accelerate Bylaws Gazetting: Finalize and enforce local Bylaws for waste, water source protection, and hazardous waste management.
- Enhance Catchment Management: Collaborate with upstream communities and stakeholders to reduce runoff, erosion, and pollution at source.
- Expand Fencing and Surveillance: Increase physical protection and surveillance around vulnerable sources e.g. Manzana Hotsprings, especially those shared with communities.

4.4.9.5 Enhance Institutional and Human Resource Capacity

- Recruit Additional Inspectors: Increase staffing for environmental and public health inspection and enforcement.
- Allocate Budget for Proactive Measures: Prioritize funding for laboratory development, monitoring technology, and staff training.

4.4.9.6 Inclusive and Participatory Planning

- Target Vulnerable Groups: Mainstream gender, youth, and disability considerations in environmental planning, service delivery, and data collection.
- Strengthen Community Engagement: Expand ward-level consultations and feedback mechanisms for continuous improvement.

4.4.9.7 Regional Collaboration

- Coordinate with Peri-Urban Areas: Develop joint waste management and water protection strategies with neighboring communities to address cross-boundary challenges.
- Formalize Collaboration with EWSC: Strengthen working relationships and data sharing with the Eswatini Water Services Corporation for integrated planning.

4.4.10 Conclusion

Ezulwini has made notable progress in infrastructure expansion, source protection, and stakeholder engagement. However, wetland disturbances, persistent water quality violations, limited monitoring capacity, and cross-boundary pressures remain critical gaps. Addressing these challenges requires urgent investment in wetland management, treatment technology, laboratory capacity, and inclusive governance to safeguard public health and ensure sustainable freshwater management.

Chapter 5: Land Use Management

"Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, halt and reverse land degradation, and halt biodiversity loss". – United Nations

5.1 Overview

The state of land use in Ezulwini is **improving**, marked by managed urban expansion, infrastructure upgrades, and a strong alignment with national and international sustainability frameworks. The Municipality has made significant progress in residential and commercial development, green space preservation, and service delivery, despite ongoing pressures from population growth, urbanization, and resource constraints. However, critical gaps remain in public land management including wetlands and infrastructure maintenance. Addressing these will be essential to sustain and accelerate positive trends in land use management.

5.1.1 Background and Context

Ezulwini is strategically located between Mbabane and Manzini in the Hhohho Region of Eswatini, covering approximately 1,720 hectares. The town is renowned as a tourism and commercial hub, with a population projected to reach 2,800 in 2024. Land ownership is predominantly private (59.4%), with the remainder held by government, parastatals, and the iNgwenyama in Trust for the Swazi Nation. The Municipality is governed under the Urban Government Act of 1969 and operates through a Council and five main departments, guided by the Integrated Development Plan (IDP) 2019–2049.

5.1.1.2 Applicable Plans, Standards, and Regulatory Framework

- Local: Ezulwini Town Planning Scheme (2018, under review for 2025), IDP 2019–2049, Comprehensive Mobility Plan (2023), Waste Regulations 2000, Public Health and Food Hygiene Regulations 1973.
- National: Urban Government Act 1969, Town Planning Act 1961, Building and Housing Act 1968, Environmental Management Act 2002, Water Act 2003, Public Health Act 1969.
- International: United Nations Sustainable Development Goals (SDGs), especially SDG 11 (Sustainable Cities and Communities), New Urban Agenda, Ezulwini Consensus (African Union, 2005).

5.2 State of Land Management in Ezulwini

5.2.1 Land Use Patterns and Changes

Ezulwini's land use profile has evolved significantly over the past five years. As of 2024, the town remains predominantly residential, with over 60% of plots designated for residential purposes. Major commercial activities are concentrated along the MR103 and D36 corridors, anchored by shopping centres and hospitality nodes. Notable conversion of vacant land to developed land has occurred, especially for residential and commercial purposes along the MR103. The town has also seen ongoing infill and densification in residential areas, as well as the formalization of informal settlements, particularly on Farm 7/706. Land ownership is largely private, accounting for 59.4%

of urban land, with the remainder held by government, parastatals, and the iNgwenyama in Trust for the Swazi Nation.

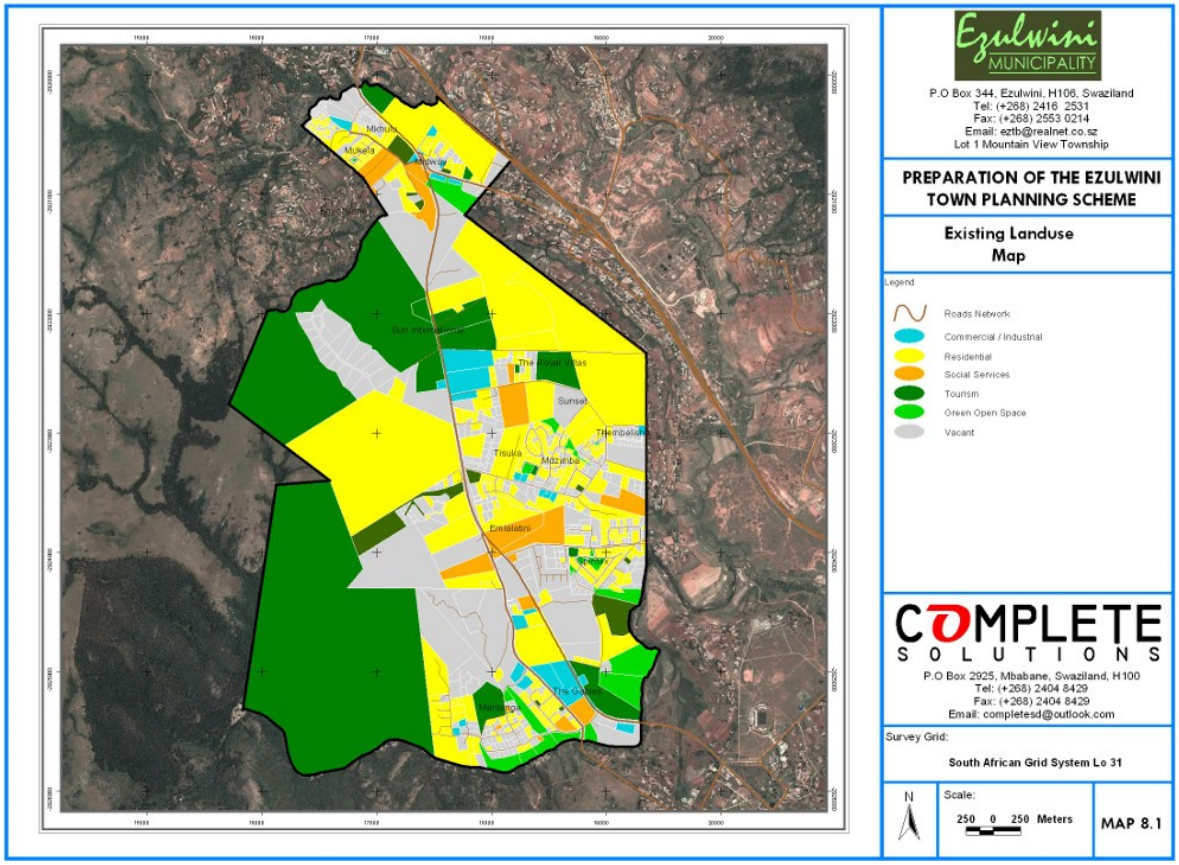

Figure 27: Existing land use map of Ezulwini (Ezulwini Municipality, 2018)

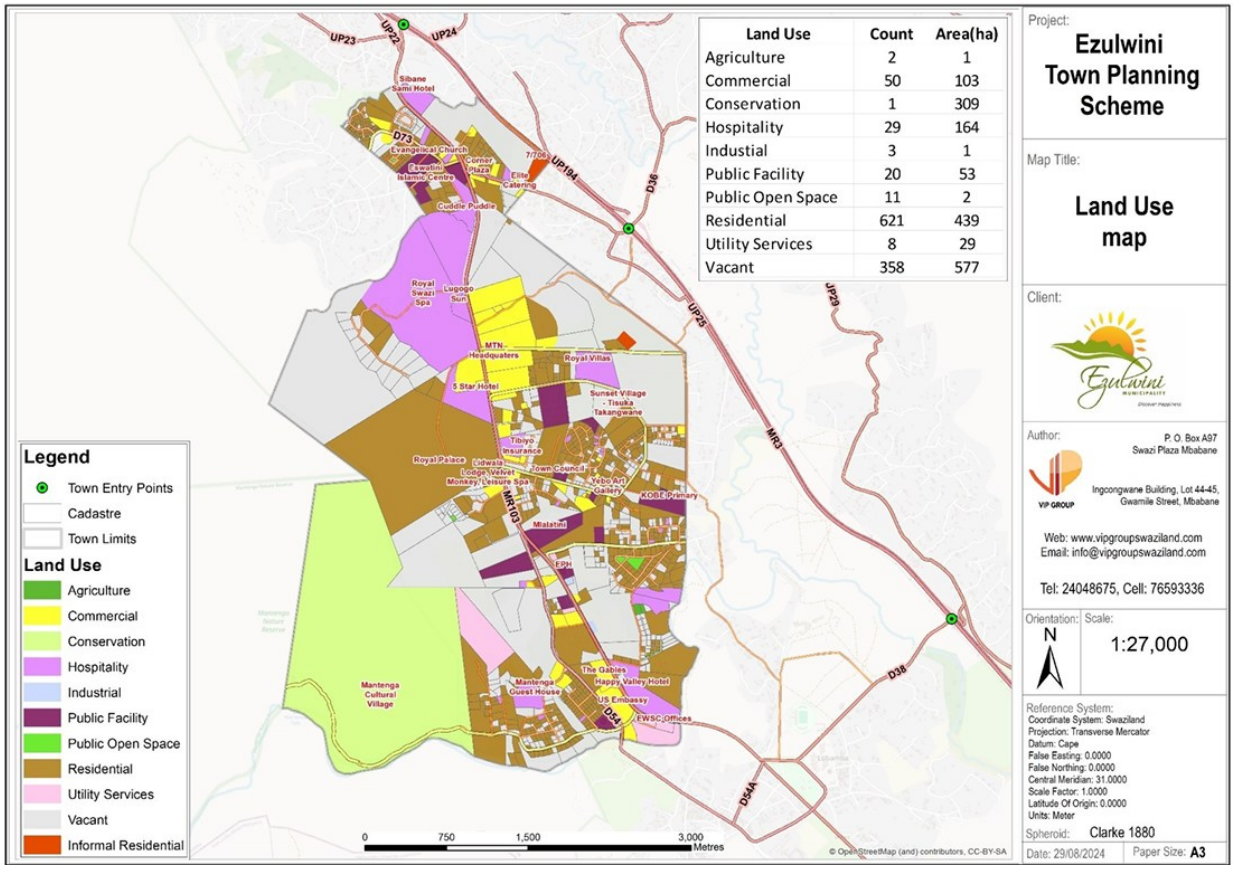

Figure 28: Proposed land use map of Ezulwini (Ezulwini Municipality, 2024)

A comparison of Figure 27 and 28 reveals key observations:

- The existing map (Figure 28) consolidates all residential areas into one category, whereas the proposed zoning differentiates density tiers from low-rise (R1) to high-rise (R4).
- Commercial and industrial corridors along MR103 and D36 are transformed into a hierarchical business district system (C1–C3) on the right.
- Public facilities (e.g., schools, clinics) are individually symbolized in the existing map but are grouped into contiguous PF zones in the new plan.
- Green open spaces, previously unclassified beyond "open," are now categorized into Active (0-1) and Regulated (0-2) zones under the Regional Open Space System.
- Vacant parcels are largely rezoned to meet future residential and public facility needs, reflecting a proactive approach to land allocation.

The comparison demonstrates a clear shift from generalized land-use depiction to a comprehensive, regulated zoning scheme intended to guide sustainable, compact growth. Residential and commercial uses are stratified by density and function, green spaces are protected within an ecological network, and public services are systematically located for accessibility. Vacant lands are no longer idle but are

strategically allocated to meet projected urban requirements, reflecting the Development Plan's forward-looking approach.

5.2.2 Green Space Coverage

Green space remains a defining feature of Ezulwini, with conservation areas constituting 18% of the town's land. The Regional Open Space System (ROSS) integrates drainage lines, wetlands, steep slopes, and high-biodiversity areas as protected green spaces. Green and recreational spaces are regularly maintained to preserve biodiversity and ensure safety. Initiatives such as tree planting, park establishment, and the creation of active green corridors with walking trails and street furniture are being implemented. Community gardens, including the PELUM Garden, and other urban agriculture initiatives are ongoing, with further plans to activate green spaces for community use.

5.2.3 Urban Development Plans

The Integrated Development Plan (IDP) 2019–2049 provides a long-term framework for sustainable growth, infrastructure improvement, and alignment with the UN Sustainable Development Goals (SDGs). The Town Planning Scheme (TPS) under development is being prepared to update land use regulations, guide zoning, and support balanced growth across residential, commercial, and tourism sectors. The Comprehensive Mobility Plan (CMP) enhances mobility, focusing on road upgrades, pedestrian and cyclist infrastructure, and improved public transport. Infrastructure investments include tar roads, street lighting, and underground utilities.

5.2.4 Building Plans and Property Values (2019–2024)

Between 2019 and 2024, Ezulwini experienced notable fluctuations in the number and value of approved building plans. The number and value of building plans peaked in 2019/20, declined during the pandemic, and stabilized in recent years. Residential projects have shifted towards higher-value developments, while commercial investment remains steady but below the 2019/20 peak.

5.2.5 Number of Approved Building Plans

The number of approved residential building plans peaked at 40 in 2019/20, with commercial plans at 4. In 2021/22, residential plans dropped to 29, and commercial data is unavailable. For 2022/23 and 2023/24, both years saw 13 residential and 9 commercial plans approved each year. Figure 29 shows a clear decline in the number of residential plans after 2019/20, stabilizing at a lower-level post-pandemic, while commercial plans increased and stabilized in the last two years.

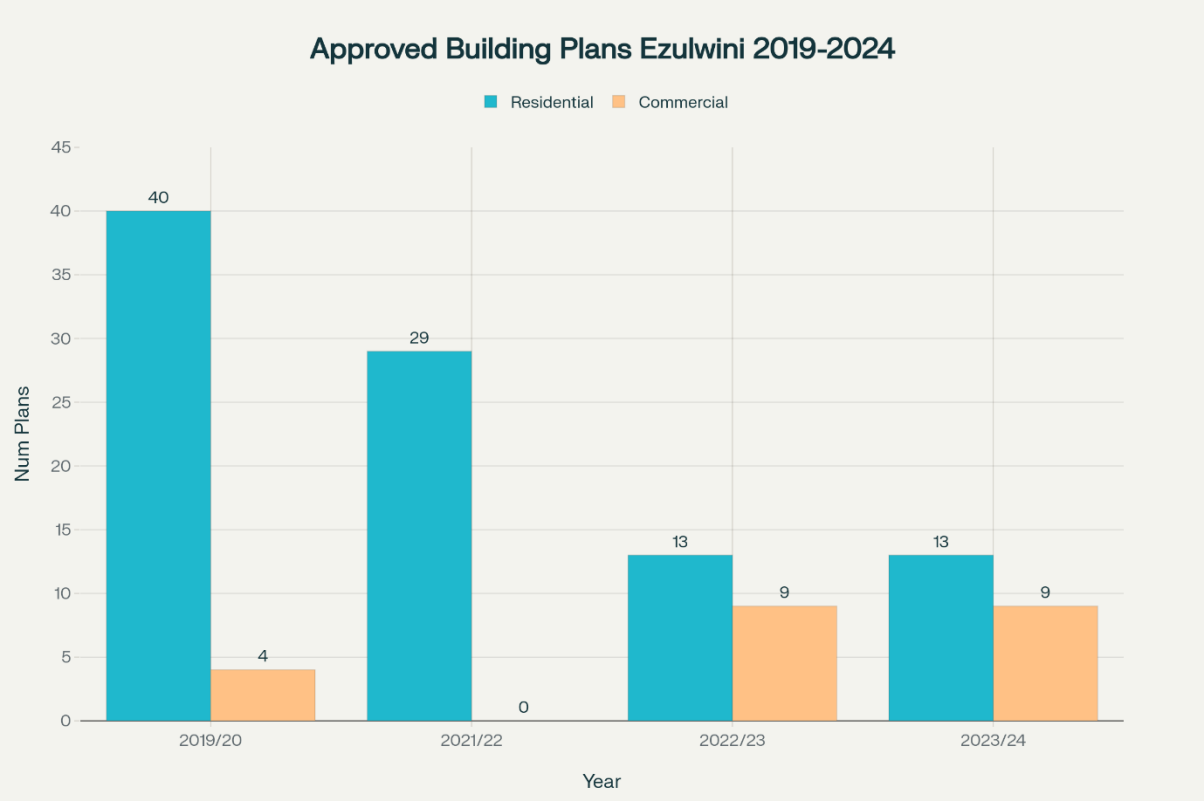

Figure 29: Number of Annual Building Plans from 2019-2024 at Ezulwini

5.2.6 Value of Approved Building Plans

In 2019/20, commercial property value was exceptionally high, reflecting major projects, while residential value was also strong. In 2021/22, residential value spiked to E150 million despite fewer plans, indicating a focus on larger or higher-value projects. Both residential and commercial values stabilized at lower levels in 2022/23 and 2023/24, suggesting a cautious but steady investment climate. The pre-pandemic period saw a boom, especially in commercial development, followed by a sharp contraction and then stabilization at more sustainable levels. Figure 30 is a grouped bar chart showing the annual value of approved residential and commercial building plans in Ezulwini from 2019/20 to 2023/24.

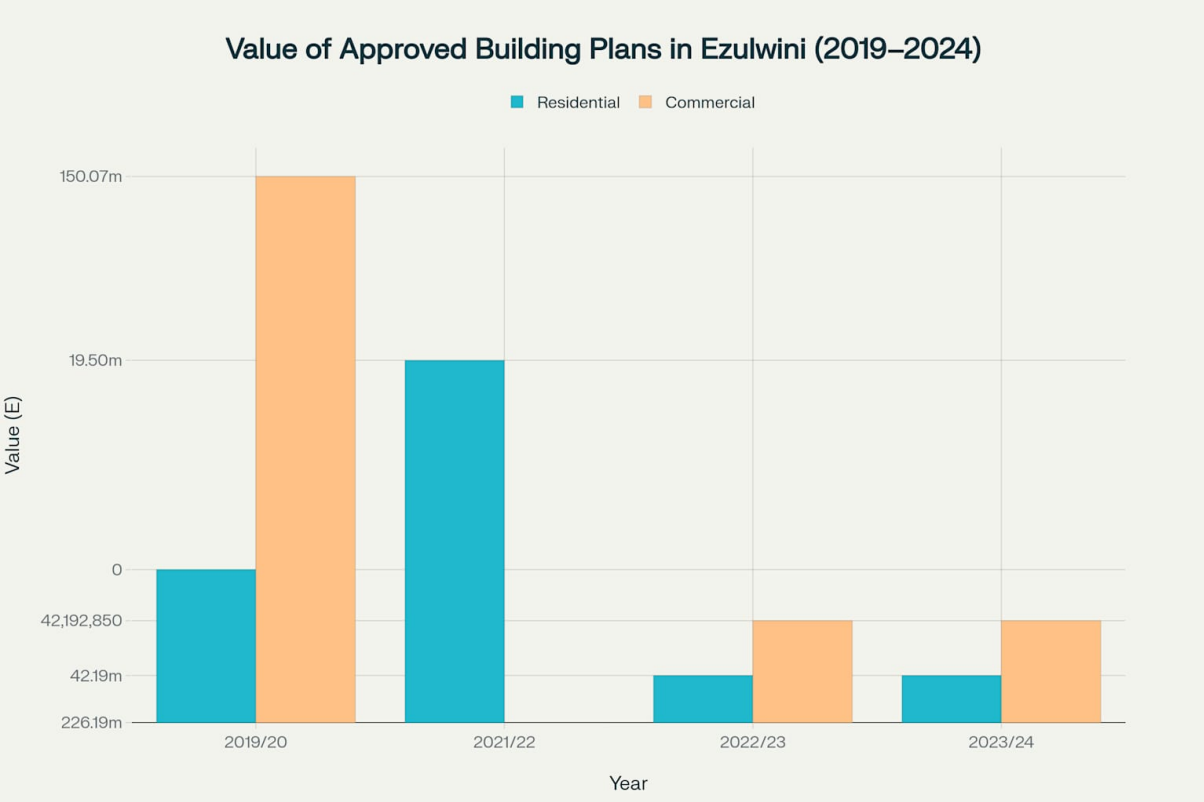

Figure 30: Annual value of approved residential and commercial building plans in Ezulwini (2019/20–2023/24)

Discussion of Trends

- 2019/20: This year saw the highest commercial building plan value, exceeding E226 million, reflecting major commercial projects. The residential value was also strong at over E63 million.
- 2021/22: There was a sharp increase in residential value to E150 million, despite the absence of reported commercial data. This suggests a shift to larger or higher-value residential projects.
- 2022/23 & 2023/24: Both years show stabilization, with residential values just under E20 million and commercial values at about E42 million. This indicates a more cautious but steady investment climate post-pandemic.
- Overall Trend: The pre-pandemic period experienced a boom, especially in commercial development. The pandemic led to a contraction in activity, followed by a period of stabilization and balanced growth in both sectors.

Key Insights include:

- The building plan values reflect Ezulwini's dynamic development environment, with significant fluctuations driven by major projects and external factors like the pandemic.
- Recent years show a return to stability, with consistent investment in both residential and commercial sectors, supporting the town's broader urban development and planning objectives.

5.2.7 Population Density

Ezulwini's population grew from 2,661 in 2016 to about 2,800 in 2024, with projections of continued steady growth. The highest residential concentration is in Ward 4, which contains 47% of residential plots, while Ward 2 has the lowest at 7.3%. Increased density has created demand for social facilities such as parks, schools, and sports fields, and has placed strain on existing infrastructure.

5.2.8 Green City Initiatives and Implementation

The green city concept focuses on creating urban areas that prioritize environmental sustainability, efficient resource use, and the well-being of residents by integrating renewable energy, sustainable infrastructure, and accessible green spaces. Benefits include reduced pollution, enhanced biodiversity, improved mental and physical health through walkable designs, and economic opportunities in green industries. Eswatini's Green City Initiative is making steady progress, with recent efforts focusing on strengthening local government capacity, improving data for urban planning, and launching key projects like the Eco-Green City in Shiselweni and a smart city pilot in Mbabane. Supported by international partners such as the FAO and African Development Bank, these initiatives aim to promote sustainable urban development, climate resilience, and job creation, positioning Eswatini's cities for a greener and more inclusive future. Ezulwini is part of this initiative and aligns with SDG 11 (Sustainable Cities and Communities), focusing on inclusivity, resilience, and sustainability. The Municipality promotes renewable energy, waste reduction, and expanded recycling, including a 139% increase in recyclable materials collected in 2023/24 and the introduction of waste separation at source. Urban agriculture, community gardens, and small-scale livestock projects support food security and green space utilization. Partnerships with organizations like PELUM and Creative Minds Foundation enhance community engagement and sustainability.

5.3 Pressures

- Population Growth: The population has grown steadily, increasing demand for housing, infrastructure, and social services.
- Urbanization: Expansion of residential and commercial developments strains existing infrastructure, especially roads, water, and waste management systems.
- Land Scarcity: Most developable land is privately owned, limiting the Municipality's ability to provide new public facilities or expand green spaces.
- Environmental Risks: Issues such as veld fires, floods, air pollution, and water contamination are ongoing concerns.
- Infrastructure Maintenance: Budget constraints and insufficient national funding affect the maintenance and upgrading of key infrastructure, including the MR103.

- Social Dynamics: Gender-based violence, crime, and underreporting of social issues present additional challenges.

5.4 Driving Forces

- Economic Development: The town's strategic location and status as a tourism and corporate hub drive demand for new developments and services.
- Policy and Governance: The IDP, Town Planning Scheme, DRR plans and CMP provide a strategic framework for risk management, sustainable growth, infrastructure, and service delivery.
- Environmental Awareness: There is a growing emphasis on green space preservation, biodiversity, and sustainable urban management, reflected in local policies and community initiatives.
- International Commitments: Alignment with the SDGs and the New Urban Agenda shapes local planning and development priorities.

5.5 Impacts

5.5.1 Positive Impacts

These include:

- Economic Growth: Local Economic Development (LED) programs, youth empowerment, and entrepreneurship training have boosted economic activity and job creation.
- Infrastructure Upgrades: Road improvements, solar street lighting, and stormwater management have enhanced safety and connectivity.
- Environmental Initiatives: Waste separation programs, tree planting, and green corridor development support urban greening and biodiversity.
- Community Well-being: Social services, health campaigns, and support for vulnerable groups improve quality of life.
- Governance: Strong financial management and stakeholder engagement contribute to effective service delivery and transparency.

5.5.2 Negative Impacts

These include:

- Environmental Degradation: Water pollution, habitat loss, and encroachment on sensitive areas including wetlands threaten ecosystem services and public health.
- Infrastructure Strain: Rapid development and population growth outpace infrastructure capacity, leading to congestion and service delivery challenges.

- Social Inequity: Limited public land and resources constrain the provision of new social facilities, affecting access and equity.
- Informal Settlements: Unplanned expansion complicates land use management and service provision, especially in peri-urban areas.

5.6 Responses

These include:

- Regulatory Framework: Enforcement of the Town Planning Scheme, zoning regulations, and building codes guide land use and development.
- Strategic Planning: The IDP, CMP, and Town Planning Scheme (2025) under development set long-term goals for sustainable growth, infrastructure, and environmental management.
- Green Initiatives: Waste separation, recycling, tree planting, and green corridor projects are being implemented to enhance environmental quality.
- Community Engagement: Stakeholder consultations, public meetings, and partnerships with NGOs and local organizations support inclusive planning and service delivery.
- Infrastructure Investment: Upgrades to roads, lighting, and stormwater systems are ongoing, with a focus on resilience and safety.

5.7 Gaps

These include:

- Public Land Availability: The lack of municipal land limits the expansion of public facilities and green spaces.
- Infrastructure Maintenance: Insufficient funding and resource constraints hinder the upkeep and upgrading of critical infrastructure.
- Data and Monitoring: Limited recent census data and local surveys impede accurate assessment of population density and service needs.
- Green Space Activation: While coverage is stable, more needs to be done to activate and expand green spaces for community use.
- Assessment of Green City Initiatives: There is no formal evaluation framework for measuring the effectiveness of green city projects.

5.8 Recommendations

These include:

- Accelerate the Review and Implementation of the New Town Planning Scheme: Finalize and enforce the new scheme with clear zoning, density

controls, and mechanisms for managing mixed-use and high-density developments.

- Expand Public Land Holdings: Explore land banking, land swaps, and negotiations with private owners to secure land for public facilities and green spaces.
- Improve Data Collection: Conduct regular local surveys and collaborate with national agencies to update population and service needs data.
- Activate and Expand Green Spaces: Prioritize the development and activation of new parks, green corridors, and urban gardens, especially in underserved areas.
- Formalize Green City Assessment: Establish a monitoring and evaluation framework for green city initiatives to measure impact and guide scaling up.
- Upgrade Mobility and Infrastructure: Fast-track CMP priorities, including road upgrades, sidewalk expansion, and public transport facilities.
- Address Social and Economic Inclusion: Allocate resources and seek partnerships to build new schools, clinics, parks, and community centres in high-density and underserved areas.
- Foster Integrated Governance and Community Engagement: Strengthen coordination with national agencies, NGOs, and private sector partners for project delivery and resource mobilization.

5.9 Conclusion

The state of land use in Ezulwini is **improving**, with clear progress in managed urban expansion, infrastructure upgrades, and alignment with sustainability frameworks. The Municipality's commitment to strategic planning, green initiatives, and community engagement has yielded positive outcomes in economic development, environmental quality, and service delivery. However, persistent gaps in public land availability, infrastructure maintenance, and the formalization of informal settlements must be addressed to sustain and accelerate these gains. Continued investment, data-driven planning, and inclusive governance will be essential for Ezulwini to achieve its vision of being a high-quality, green, and inclusive urban center.

Chapter 6: Energy Management

"We cannot save a burning planet with a fire hose of fossil fuels" – UN Secretary General

6.1 Overview

The state of energy management in Ezulwini Municipality is **improving** overall, characterized by notable progress in renewable energy adoption and efficiency measures, but facing significant challenges from projected demand surges and infrastructure constraints. Between 2020-2024, the Municipality experienced substantial volatility in energy consumption, with an initial growth phase (2020-2021) followed by a marked decline (2022-2024) due to energy efficiency initiatives, Time-of-Use tariffs, and COVID-19 impacts. However, forecasts indicate a sharp 76.7% increase in consumption between 2025-2029, driven by major infrastructure projects including the Central Bank and New Parliament developments.

Key achievements include the installation of an additional 85 solar-powered streetlights, implementation of waste separation programs that reduced landfill waste by 15.6%, and successful adoption of demand-side management strategies. Despite these positive developments, critical gaps persist in systematic energy management certification (ISO 50001), granular data collection, and infrastructure capacity to meet projected demand growth. The Municipality's proactive approach to renewable energy integration and efficiency measures demonstrates commitment to sustainable energy management, though sustained investment and regulatory reform are essential to maintain progress.

6.1.1 Background and Context

6.1.1.1 National Regulatory Framework

Eswatini's energy management operates within a comprehensive national policy framework anchored by the National Energy Policy, which prioritizes sustainable energy development and aims for a 50% renewable share in the energy mix. The policy framework is supported by key legislation including the Eswatini Electricity Company Act (2007), Electricity Act (2007), and Energy Regulatory Act (2007), which collectively promote sector reform, private sector involvement, and regulatory oversight.

The Energy Masterplan (2034) sets ambitious targets for reducing annual electricity consumption by 400,000 MWh by 2034, with Minimum Energy Performance Standards (MEPS) established for lighting equipment. The Eswatini Standards Authority has adopted ISO 50001 as the national standard (SZNS ISO 50001), enabling organizations to systematically improve energy performance, efficiency, and cost-effectiveness.

6.1.1.2 International Frameworks

Ezulwini's energy management aligns with international frameworks, particularly the United Nations Sustainable Development Goals (SDGs). The Municipality contributes directly to SDG 7 (affordable, reliable, sustainable, and modern energy for all) through renewable energy adoption, efficiency initiatives, and expanded access programs. As an urban local authority, Ezulwini's core deliverable is SDG 11, which focuses on "making cities and human settlements inclusive, safe, resilient and sustainable". The

Municipality operates within the broader context of the New Urban Agenda, recognizing it as a critical lever to accelerate SDG achievement. This framework emphasizes integrated energy planning, sustainable urban development, and climate-responsive infrastructure management.

6.2 State of Energy Management in Ezulwini

6.2.1 Energy Consumption Patterns

Ezulwini's electricity consumption has been shaped by commercial expansion, residential growth, and the hospitality sector. Figure 31 illustrates historical and forecasted trends in both annual energy consumption (GWh) and peak demand (KVA):

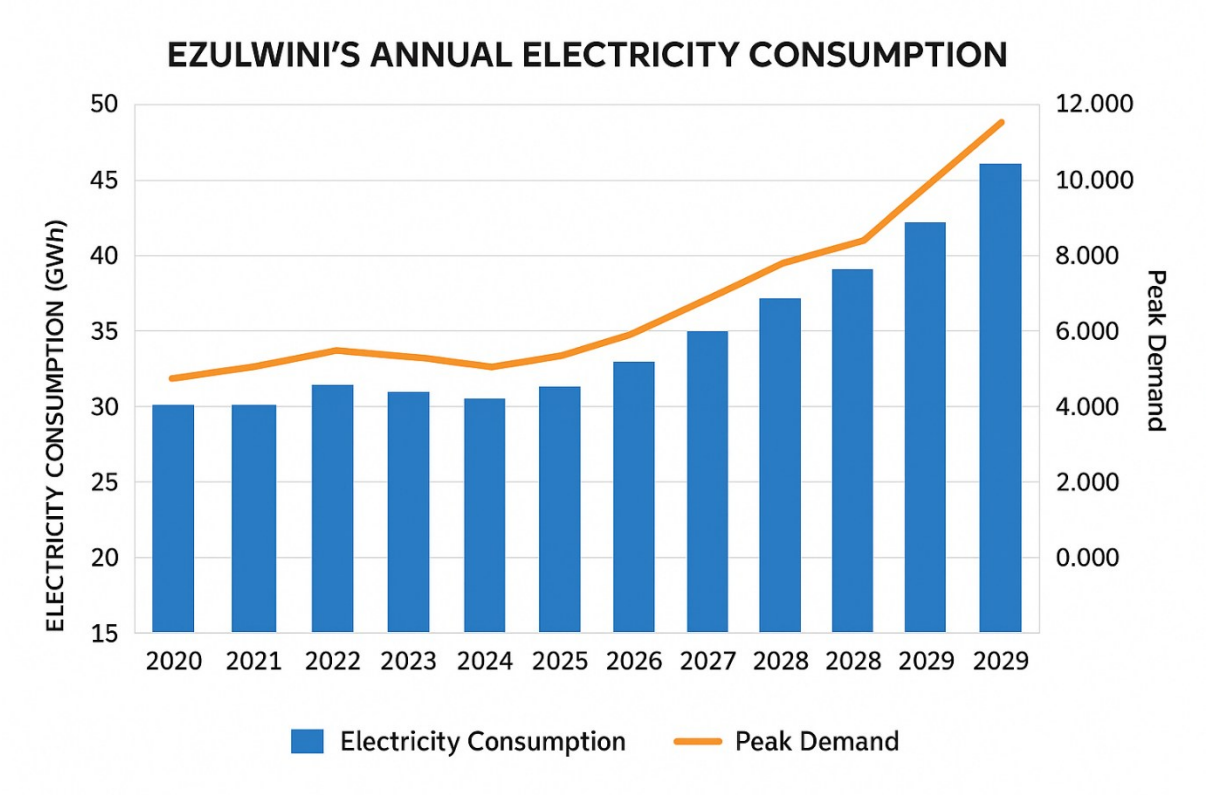

Figure 31: Ezulwini Municipality annual electricity consumption and projection (2020-2029) (EEC, 2025)

Key Insights and Interpretations include:

a) Historical Trends (2020–2024) Growth Phase (2020–2021):

- Both energy consumption and peak demand increased, peaking in 2021.
- This growth is attributed to commercial expansion (shopping malls, hotels, office parks) and new residential developments, with the hospitality sector being a major driver.

- Decline Phase (2022–2024):
  - There is a notable decline in both indicators, with energy consumption dropping from 127.99 GWh (2021) to 96.06 GWh (2024), and peak demand falling from 14,610.44 KVA to 10,965.89 KVA.

- The decline is linked to energy efficiency programs (LED lighting, retrofits), Time-of-Use tariffs, and the economic impacts of the COVID-19 pandemic.

b) Forecasted Trends (2025–2029)

- Sharp Rebound and Growth (2025–2029):
    - A dramatic increase is projected from 2025 onward, especially in 2026, where both energy consumption and peak demand rise sharply.
    - This growth is driven by major developments, notably the Central Bank and New Parliament projects, as well as continued commercial and residential expansion.
    - By 2029, energy consumption is projected to reach 173.90 GWh, and peak demand 19,851.91 KVA, representing a 76.7% increase from the 2024 baseline.

c) Patterns and Takeaways

- Cyclical Demand: The graph shows that energy demand in Ezulwini is highly responsive to economic cycles, infrastructure projects, and policy interventions.
- Infrastructure Pressure: The anticipated surge in peak demand will place significant strain on the existing Lobamba substation and distribution infrastructure, highlighting the need for timely upgrades and grid enhancements.
- Effectiveness of Efficiency Measures: The temporary reduction in both consumption and demand during 2022–2024 demonstrates the tangible impact of targeted efficiency and demand-side management initiatives.
- Planning Imperative: The sharp projected increase underscores the importance of proactive planning, investment in smart metering, and regulatory frameworks for distributed generation to maintain grid reliability and sustainability.

d) Main Takeaways

- Short-term dips in energy use can be achieved through efficiency and demand management, but long-term growth is inevitable with urban and economic expansion.
- Major infrastructure and commercial projects are the primary drivers of future demand spikes.
- Ezulwini must prioritize infrastructure upgrades, regulatory reforms, and continued efficiency programs to balance growth with sustainability and reliability.

6.2.2 Renewable Energy Adoption

6.2.2.1 Installed Capacity (2024)

Ezulwini benefits from national and local renewable energy initiatives, as shown in Table 8:

Table 8: National Renewable Initiatives

Technology	***Installed Capacity***	***Category***
Solar PV	10 MW	Utility-scale
Hydro	60.5 MW	Utility-scale
Solar PV	~800 kW	Embedded (Ezulwini area)

- Drivers: National policy (Eswatini Electricity Act), donor programs (EU/UNDP CREATE, World Bank ASCENT), and environmental awareness.
- Key Initiatives: Promotion of solar water heaters, embedded generation frameworks, and off-grid solar solutions.
- Challenges: Intermittency of solar PV, lack of battery storage, and incomplete tariff structures for embedded generation.

6.2.3 Energy Efficiency Measures

6.2.3.1 Major Initiatives

- LED Lighting & Efficient Appliances: Campaigns and retrofits in public and private sectors.
- Time-of-Use Tariffs: Encourage large users to shift consumption to off-peak hours.
- Smart Metering: Piloted to improve transparency and enable better demand management.
- Building Retrofits & Geyser Optimization: Reduce peak load and overall consumption.

These measures contributed to the decline in consumption from 2022–2024 and are planned for further expansion.

6.2.4 Access to Electricity

6.2.4.1 Progress and Challenges

- Grid Expansion: The Rural Electrification Programme has extended grid access to Ezulwini's outskirts, increasing access for new residential and commercial customers.
- Solar Public Lighting: Installation of an additional 85 solar streetlights in residential areas to improve safety and reduce grid dependency.

- Barriers: Infrastructure expansion is limited by underground cabling constraints and challenges in acquiring easements for new developments.
- Future Demand: Major projects are expected to increase consumption by 76.7% between 2025 and 2029.

6.3 Driving Forces

6.3.1 Economic and Demographic Drivers

Ezulwini's energy demand is primarily driven by robust economic growth and urbanization:

- Commercial Development: Expansion of shopping malls, hotels, office parks, and new residential estates
- Hospitality Sector: Hotels and lodges significantly increasing consumption through lighting and air conditioning
- Population Growth: New household connections and expanding residential areas
- Government Infrastructure: Major projects including Central Bank, Parliament, and health facilities

6.3.2 Policy and Technological Initiatives

National policy directions and technological advancement drive renewable energy adoption:

- Eswatini Electricity Act: Promoting renewable energy integration
- Donor Programs: EU/UNDP CREATE and World Bank ASCENT initiatives
- Embedded Generation Frameworks: Supporting decentralized renewable systems
- Smart Grid Development: Planned rollout for enhanced monitoring and control

6.4 Pressures

6.4.1 Infrastructure and Technical Constraints

Several critical pressures challenge Ezulwini's energy management:

- Grid Capacity Limitations: Lobamba substation approaching capacity limits
- Underground Cabling Constraints: Limited sleeves restricting new connections
- Renewable Integration Challenges: Solar PV intermittency without adequate storage solutions
- Forecasting Difficulties: Unpredictable events (pandemics, extreme weather) complicating demand planning

6.4.2 Regulatory and Market Gaps

- Incomplete Market Rules: Tariff structures for embedded generation under development
- Resource Constraints: Limited financial and human resources for proactive monitoring
- Coordination Challenges: Need for better integration between EEC and municipal planning processes

6.5 Impacts

6.5.1 Positive Impacts

6.5.1.1 Environmental Benefits:

- Reduced grid dependency through solar streetlight installations
- Decreased waste-to-landfill through separation programs (15.6% diversion rate)
- Lower greenhouse gas emissions from renewable energy adoption

6.5.1.2 Economic Benefits:

- Cost containment through solar infrastructure deployment
- Job creation through energy sector development
- Enhanced energy security through diversified supply sources

6.5.1.3 Social Benefits:

- Improved public safety through solar lighting in residential areas
- Enhanced access to electricity through grid expansion programs

6.5.2 Negative Impacts

6.5.2.1 Infrastructure Strain:

- Potential supply reliability issues from infrastructure bottlenecks
- Increased operational costs from rising demand
- Grid stability challenges from renewable intermittency

6.5.2.2 Economic Pressures:

- Higher energy costs for consumers and Municipality
- Investment requirements for infrastructure upgrades
- Resource allocation challenges between competing priorities

6.6 Responses

6.6.1 Implemented Measures

6.6.1.1 Efficiency Programs:

- LED retrofits across public infrastructure
- Time-of-Use tariff implementation for commercial customers
- Smart metering pilot programs in select areas
- Building retrofits and geyser optimization initiatives

6.6.1.2 Renewable Energy Initiatives:

- Additional 85 solar streetlights installed across six residential streets
- Participation in Africa Energy Indaba for renewable solutions exploration
- Support for embedded solar PV installations (~800 kW capacity)

6.6.1.3 Infrastructure Development:

- Lobamba substation upgrade planning
- Grid expansion through Rural Electrification Programme
- Underground cabling infrastructure development

6.6.1.4 Strategic Partnerships

- International Collaboration: EU/UNDP CREATE and World Bank ASCENT programs
- Regional Engagement: Africa Energy Indaba participation
- Stakeholder Coordination: Annual general meetings and integrated development planning

6.7 Critical Gaps

6.7.1 Data and Monitoring

- Sectoral Disaggregation: Limited breakdown of consumption by residential, commercial, and industrial sectors
- Electrification Metrics: Absence of household electrification rates and vulnerable group access data
- Efficiency Impact Assessment: Lack of quantified savings from efficiency measures
- Water-Energy Nexus: Insufficient integration of water and energy consumption data.

6.7.2 Infrastructure and Regulation

- Storage Solutions: No large-scale battery storage for renewable integration

- Systematic Energy Management: ISO 50001 certification not yet achieved
- Regulatory Frameworks: Incomplete tariff structures for embedded generation

6.7.3 Social and Environmental

- Inclusivity: Limited targeting of vulnerable groups (women, youth, people with disabilities) in energy planning
- Cross-boundary Coordination: Need for better collaboration with peri-urban communities

6.8 Recommendations

6.8.1 Infrastructure and Policy

- Accelerate Infrastructure Upgrades: Facilitate the prioritization of Lobamba substation expansion and grid enhancements by EEC to accommodate projected 76.7% demand increase.
- Expedite Regulatory Development: Facilitate the finalization of tariff structures and market rules by EEC for embedded generation to encourage distributed solar adoption
- Invest in Storage Solutions: Deploy battery storage and hybrid systems to address solar PV intermittency and enhance grid stability for municipal properties.
- Expand Smart Infrastructure: Facilitate the rolling out of smart meters by EEC to all commercial and residential users for real-time monitoring and demand management

6.8.2 Data and Planning

- Enhance Data Systems: Collaborate with EEC to obtain disaggregated consumption data by sector and user type.
- Strengthen Monitoring: Quantify and report efficiency measure impacts, including kWh savings and cost reductions
- Integrate Water-Energy Planning: Coordinate with EWSC for comprehensive utility planning

6.8.3 Social and Environmental

- Mainstream Inclusivity: Integrate gender, youth, and disability considerations into energy access and planning processes
- Enhance Stakeholder Engagement: Ensure targeted consultations with vulnerable groups and peri-urban communities

6.8.4 Strategic Partnerships

- Leverage International Support: Continue engagement with EU/UNDP, World Bank, and other development partners

- Strengthen Regional Collaboration: Partner with neighbouring municipalities for knowledge sharing and joint initiatives
- Formalize Utility Partnerships: Establish formal MOUs with EEC and EWSC for coordinated planning and service delivery

6.9 Conclusion

Ezulwini Municipality's energy management state is demonstrably **improving**, with significant achievements in renewable energy adoption, efficiency implementation, and sustainable planning practices. The successful deployment of solar infrastructure, reduction in peak demand through efficiency measures, and proactive planning for future growth demonstrate strong institutional capacity and commitment to sustainable energy management.

However, the Municipality faces a critical juncture as projected demand surges threaten to overwhelm existing infrastructure capacity. The forecasted 76.7% increase in consumption between 2025-2029 requires immediate and sustained investment in grid infrastructure, regulatory reform, and advanced energy management systems. Success in managing this transition will depend on accelerating infrastructure upgrades, finalizing embedded generation frameworks, and strengthening partnerships with key utilities and development partners.

The foundation for continued improvement exists through established efficiency programs, growing renewable capacity, and strong stakeholder engagement processes. With targeted investment in critical gaps particularly systematic energy management certification, enhanced data systems, and inclusive planning approaches, Ezulwini is well-positioned to maintain its improving trajectory while serving as a model for sustainable municipal energy management in the region.

Chapter 7: Air Quality and Climate Change

"Climate change is the single greatest threat to a sustainable future but, at the same time, addressing the climate challenge presents a golden opportunity to promote prosperity, security and a brighter future for all." – United Nations

7.1 Overview

Ezulwini's air quality and climate indicators show mixed trends. While waste recycling initiatives and solar streetlight installations reflect positive responses, reliance on external waste disposal and absence of direct pollutant monitoring signal persistent gaps. Greenhouse gas emissions from transporting waste to Matsapha and from wastewater treatment plant remain key pressures. Climate impacts including flooding, water contamination, and heat stress are rising, but disaster preparedness and ecosystem restoration efforts offer mitigation potential. Overall, the state is **stagnant**: some improvements in waste and energy measures offset by persistent pollution sources and infrastructural vulnerabilities.

7.1.1 Background and Context

Ezulwini Municipality sits in Hhohho Region, Eswatini, between Mbabane and Manzini, declared town council in 2012 and covering 1,720 ha. It implements national laws (Urban Government Act 1969; Public Health Act 1969; Environmental Management Act 2002) and drafts local Bylaws for waste, noise and air pollution control. Internationally, Ezulwini aligns with the Paris Agreement goals and the African Union's Ezulwini Consensus on climate and security.

7.2 Air Pollutant Levels

7.2.1 Indirect Air Quality Indicators

While direct air pollutant monitoring data is not available in the municipal reports, several indirect indicators provide insights into air quality status. The Municipality monitors activities that significantly impact air quality, including waste management, transportation, and construction activities.

7.2.1.1 Waste-Related Air Quality Impacts

- Total waste generation decreased from 2,432 tonnes (2022-2023) to 2,286 tonnes (2023-2024), representing a 6.0% reduction.
- Waste to landfill reduced by 15.0%, from 2,269 tonnes to 1,929 tonnes, directly reducing methane emissions.
- Recycling rate improved dramatically from 6.7% to 15.6%, reducing the need for resource extraction and associated emissions.

7.2.1.23 Transportation and Infrastructure

- Asphalt road coverage increased from 80% to 84%, improving traffic flow and reducing vehicle emissions from poor road conditions.
- A comprehensive transport plan was completed in 2023-2024, addressing traffic congestion and emissions
- Construction project monitoring remained stable at 7 projects annually, ensuring environmental compliance.

7.4 Greenhouse Gas Emissions

7.4.1 Emission Source Analysis

7.4.1.1 Waste Management Sector

The waste management sector represents a significant source of greenhouse gas emissions, with improvements noted in 2023-2024. The introduction of waste separation at source in Ward 4 achieved an 11.8% diversion rate, significantly reducing methane emissions from landfill decomposition.

7.4.1.2 Energy Sector:

A breakthrough occurred in 2023-2024 with the installation of 85 solar streetlights, transitioning from conventional energy-intensive lighting systems. This initiative represents the Municipality's first major renewable energy deployment, directly reducing carbon emissions from electricity consumption.

7.4.1.3 Transportation

While the Municipality completed its comprehensive mobility plan in 2023-2024, public transport infrastructure remains limited. The improved road network (84% asphalt coverage) contributes to reduced vehicle emissions through better traffic flow.

7.4.1.4 Commercial Development

Development activity decreased from E85 million (2022-2023) to E62 million (2023-2024), potentially reducing construction-related emissions. However, ongoing monitoring ensures environmental compliance for all 22 building applications processed in 2023-2024. Figure 32 summarizes the above performance into a dashboard.

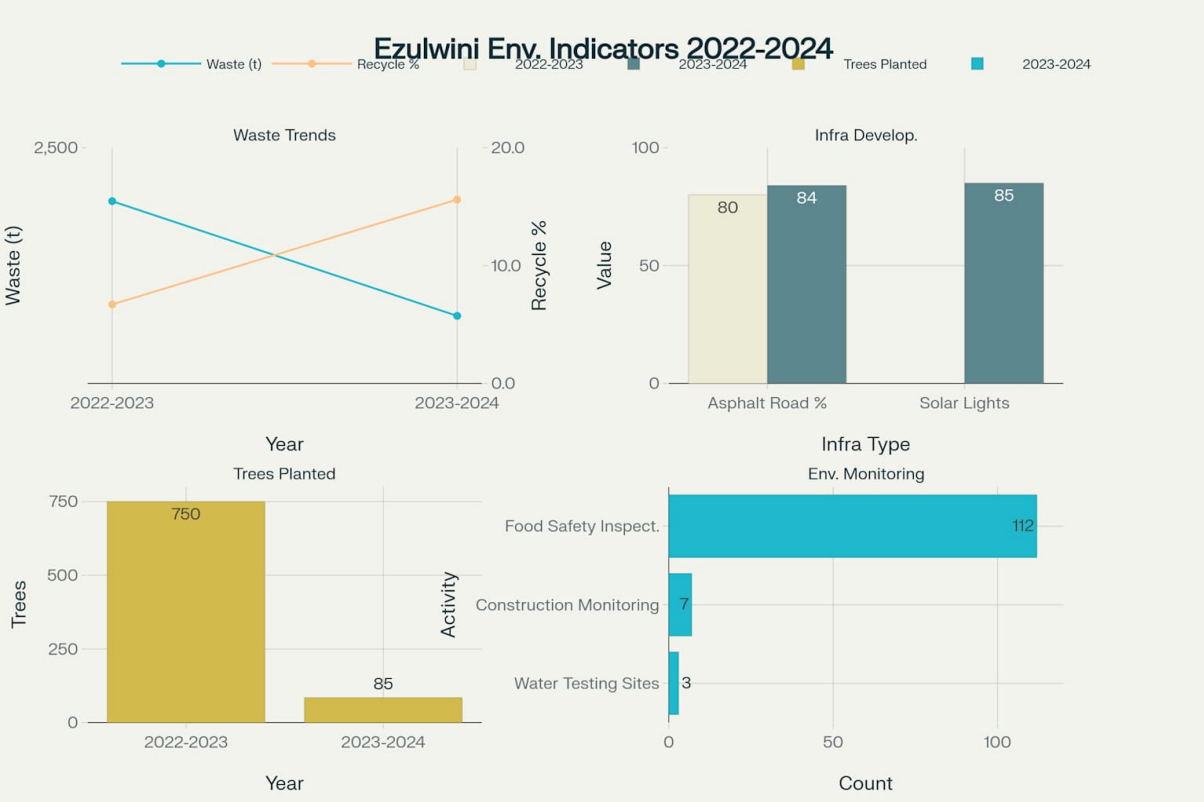

Figure 32: Ezulwini Municipality Environmental Performance Dashboard (2022-2024)

7.5 Climate Change Impacts

7.5.1 Water Resources

Climate change impacts on water resources are evident through contamination issues identified in municipal water testing. Annual water quality testing at three sites (Mkhondolwane River, Lusushwana River, and Cuddle Puddle) reveals concerning levels of E. coli and coliforms, indicating environmental stress.

The Municipality has engaged with stakeholders including the Ministry of Health, traditional leaders, and NGOs to address water quality concerns. Community awareness campaigns promote the use of boiled or bottled water for drinking and cooking.

7.5.2 Hydroclimatic Shifts (2021–2024)

Analysis of Elangeni-Malkerns climate data (Ezulwini climate data reference points) reveals:

7.5.2.1 Temperature

- Maximum: Increased by 2.6°C in Ezulwini (2021: 26.9°C → 2024: 29.5°C).
- Minimum: Winter lows rose 1.3°C, reducing frost days.

Figure 33 depicts maximum and minimum temperature averages for Ezulwini and Malkerns from 2021 to 2024.

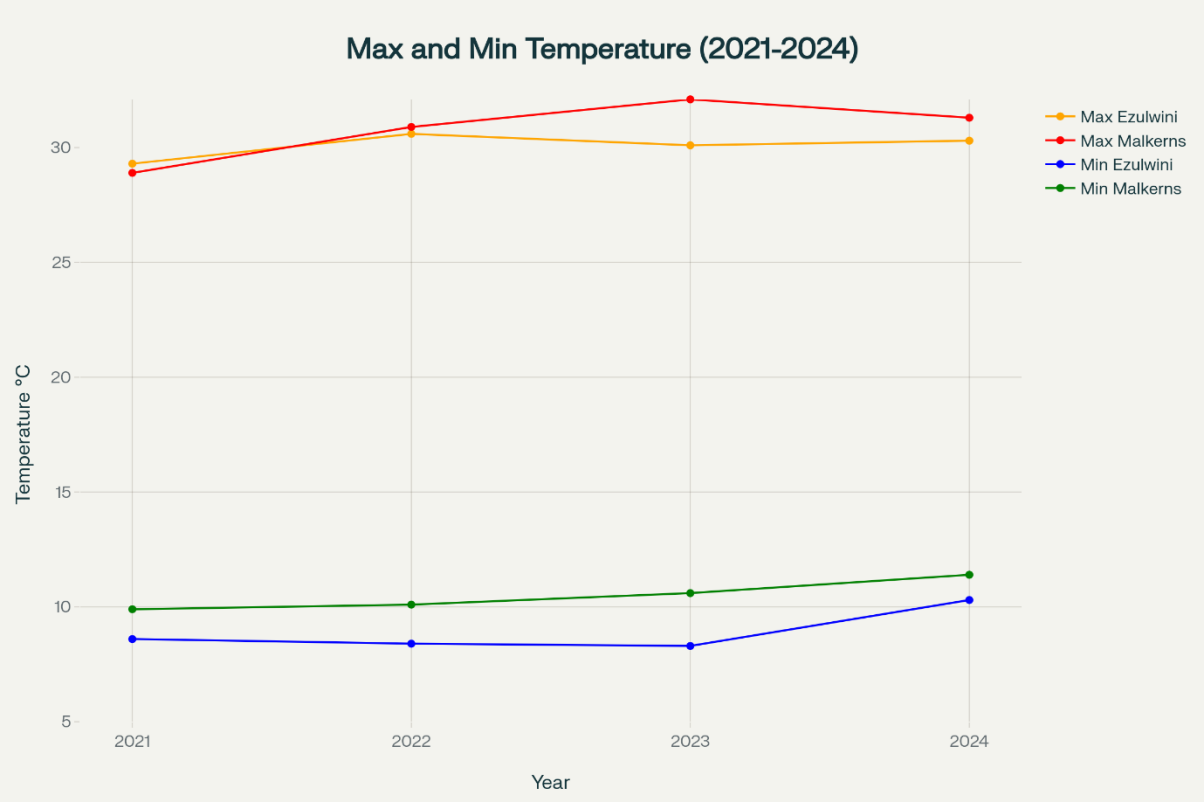

Figure 33: Temperature averages of Ezulwini from 2021-2024 *Source: Dept. of Meteorology (2025)*

Key Observations:

a) Increasing Maximum Temperatures:

- Maximum temperatures rose consistently over the years:
  - Ezulwini/Langeni recorded an increase from approximately 27.8°C in 2021 to a peak of 30.8°C in 2024.
  - Malkerns followed a similar trajectory, rising from around 26.9°C in 2021 to a high of 29.5°C in 2024.
- The warming trend indicates intensifying heat stress conditions.

b) Minimum Temperatures:

- Winter lows (June-July) showed a gradual increase:
  - Ezulwini/Langeni's minimum temperatures rose from approximately 6.6°C in winter months of 2021 to around 9.4°C by winter of 2024.
  - Malkerns exhibited similar warming trends during winter months.
- Reduced frost days may negatively impact crops requiring cold conditions for vernalization (e.g., maize).

c) Seasonal Temperature Extremes:

- The annual temperature range widened significantly by 2024, with Ezulwini recording extremes between approximately 9.4°C (minimum) and 30.8°C (maximum).
- This widening range reflects greater seasonal variability, which can disrupt ecosystems and agricultural cycles.

Implications:

- Heat Stress Risks: Rising maximum temperatures pose risks to human health (e.g., dehydration) and livestock productivity while increasing energy demand for cooling systems.
- Ecosystem Disruption: Warming trends threaten biodiversity by altering habitats and encouraging invasive species proliferation.
- Urban Heat Island Effect: As urbanization increases in Ezulwini, higher temperatures may exacerbate heat stress within built environments.

7.5.2.2 Rainfall

- Dry season (Jun–Aug): 38% decline since 2021, with 2024 totals at 25.6 mm.
- Extreme events: February 2023 saw 318.4 mm rainfall, causing river flooding.

The graph in Figure 34 provides a visual representation of rainfall trends in Ezulwini and Malkerns, focusing on total annual rainfall, dry season rainfall (June-August), and wet season variance over the years 2021, 2023, and 2024.

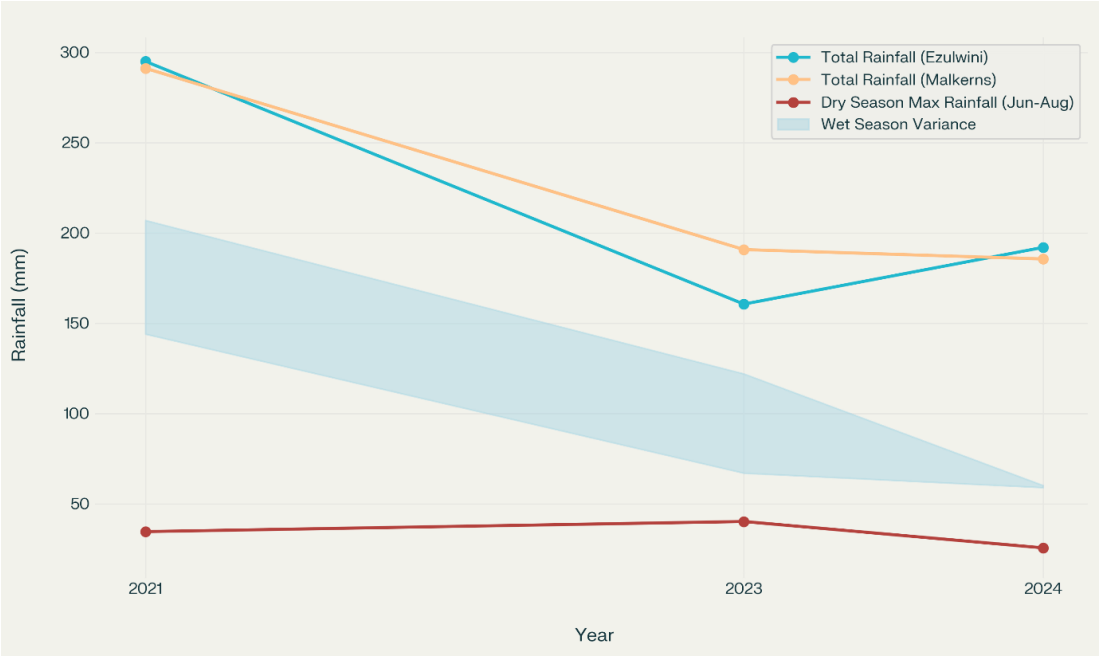

Figure 34: Rainfall Trends in Ezulwini and Malkerns Dry and Wet Season Variance 2021 -2024 (Dry and Wet Season) (Dept. of Meteorology, 2025)

Key observations and insights from the graph are as follows:

Total Rainfall Decline

- Ezulwini: Total rainfall decreased significantly from 295 mm in 2021 to 160.6 mm in 2023, followed by a slight recovery to 192mm in 2024.
- This decline highlights an overall reduction in annual precipitation, likely linked to climate change impacts such as shifting weather patterns and prolonged droughts.

Dry Season Rainfall

- Dry season rainfall (June-August) shows a marked decrease across all years:
    - In 2021, dry season rainfall ranged between 6.4 mm and 34.6 mm.
    - By 2023, this range narrowed to just 0.8 mm to 40.2 mm.
    - In 2024, dry season rainfall dropped further, with values ranging from 0 mm to only 25.6 mm.
- The consistent reduction during the dry season suggests intensifying drought conditions, which could exacerbate water scarcity challenges for agriculture and households.

Wet Season Variance

- Wet season peaks demonstrate significant variability:
    - In 2021, wet season peaks ranged between 144 mm and 207 mm, indicating relatively stable precipitation during the rainy months.
    - In 2023, extreme events caused peaks to fluctuate dramatically between just 67 mm and an unprecedented high of 318.4 mm (February).
    - By 2024, wet season peaks stabilized at much lower levels (59–60.2 mm), reflecting reduced intensity of rainfall events.
- This variance underscores the unpredictability of wet season precipitation, with implications for flood risks during extreme events and reduced water availability during drier periods.

Implications for Climate Change

The graph illustrates clear evidence of changing climatic patterns:

- Reduced total rainfall aligns with global trends of decreasing precipitation in semi-arid regions due to climate change.
- Extreme wet season events (e.g., February 2023) highlight the increasing frequency of intense weather phenomena, such as storms and floods.
- Prolonged dry spells during the dry season exacerbate drought conditions, threatening a water supply system, and ecosystem health.

7.5.3 Biodiversity and Ecosystem Health

Invasive alien species represent a significant climate-related challenge, with mechanical control methods implemented along the MR103 corridor. In 2023-2024, the Municipality mapped invasive species and integrated their control into disaster management planning. Tree planting initiatives varied significantly between years: 750 indigenous trees were planted in 2022-2023, while 85 trees were planted during World Environment Day 2023-2024. This variation reflects the need for consistent ecosystem restoration efforts.

7.5.4 Infrastructure Vulnerability

Climate impacts on infrastructure are addressed through ongoing maintenance and upgrade programs. The Municipality's achievement of 84% asphalt road coverage enhances resilience to extreme weather events such as waterlogging and damage to road surfaces and pavements. Drainage improvements and stormwater management systems have been implemented in areas like Umdoni Township.

7.5.5 Public Health Implications

Food safety challenges linked to climate variability are managed through regular inspections and health clearance processes such as sampling and analysis of food products to ensure public health implications that can lead to foodborne illnesses are eliminated through improved food safety practices as grading of food premises. The Municipality issued 33 health clearance certificates in 2023-2024, representing a 37.5% increase from the previous year. Enhanced food safety monitoring helps protect public health from climate-related health risks which may be due to heavy rainfall and flooding contaminating water sources; increased temperatures accelerating growth of pathogens in ready to eat food and access to safe drinking water exacerbated by severe drought conditions.

7.5.6. Adaptation and Mitigation Measures

7.5.6.1 Ecosystem-Based Adaptation

Vegetation Management:

- Implementation of invasive alien species control programs with mechanical removal methods.
- Tree planting initiatives supporting urban forest development.
- Integration of biodiversity conservation into disaster risk management planning.

Water Resource Protection:

- Annual water quality monitoring at three strategic sites.
- Community education programs on water safety.
- Stakeholder engagement for water resource management.

7.5.6.2 Infrastructure Adaptation

Transportation Resilience:

- Achieved 84% asphalt road coverage, exceeding the 80% target set for 2024.
- Completed comprehensive mobility plan addressing climate-resilient transportation.
- Infrastructure monitoring ensures climate adaptation considerations in new developments.

Energy Efficiency:

- Installation of 85 solar streetlights representing the first major renewable energy initiative.
- Cost containment objectives driving energy efficiency measures.
- Green building considerations integrated into development approvals.

7.5.6.2 Waste Management Mitigation

Source Reduction:

- Ward 4 waste separation pilot program achieving increased diversion rate.
- Overall recycling rate improvement from 6.7% to 15.6%.
- 139% increase in recyclable materials collected.

Circular Economy Initiatives:

- Implementation of waste characterization studies to understand seasonal variations.
- Gwacatela Project on composting of food waste
- Partnership with Buka community for buy-back center development.
- Reduction in waste disposal costs from E50,000-60,000 to E30,000-40,000 monthly.

7.5.7 Disaster Preparedness

7.5.7.1 Risk Management Framework:

The Municipality completed a comprehensive three-volume Disaster Risk Management Plan identifying five priority hazards: fire outbreaks, flooding, lightning and hailstorms, air pollution, and infrastructure failures. This plan integrates climate change adaptation considerations.

7.5.8 Emergency Response Capabilities

- First-ever fire hydrant assessment conducted Municipality-wide.
- Development of flood maps for Ezulwini.
- Establishment of emergency response protocols.

- Annual emergency drill requirements for all entities.

7.5.9 Policy and Governance

7.5.9.1 Regulatory Framework

Development and submission of 11 Bylaws to the Ministry of Housing and Urban Development. Implementation of ISO 9001:2015 Quality Management System for improved service delivery. Integration of climate considerations into municipal planning processes.

7.5.10 Natural Disaster Management Plan Integration

7.5.10.1 Climate-Related Hazard Identification

The Disaster Risk Management Plan identifies air pollution as one of five priority hazards, demonstrating recognition of air quality as a climate-related risk. Fire outbreaks rank as the highest priority hazard, with comprehensive assessment and response planning.

Flooding represents a seasonal climate risk with dedicated flood mapping and early warning systems. Lightning and hailstorms are identified as weather-related hazards requiring preparedness measures.

7.5.10.2 Adaptation Integration

The disaster management framework integrates climate adaptation through:

- Invasive alien species control programs mapped and budgeted under disaster management
- Water quality monitoring as part of environmental health disaster prevention
- Infrastructure resilience planning incorporating climate projections
- Community preparedness programs addressing climate-related emergencies

7.6 Pressures and Driving Forces

7.6.1 Urbanization and Development

Rapid commercial and residential growth drives traffic, construction dust, and waste generation; private infrastructure investment reached E289 million in 2019/204.

7.6.2 Transport Emissions

MR103 corridor congestion elevates NO_x and PM levels; private vehicles constitute 39% of traffic mode, followed by walking (34%) and taxis (26%).

7.6.3 Waste Management

Total waste rose to 2,286 t in 2023/24 (55.7% commercial, 28.5% residential); landfill reliance emits methane and CO_2 over the 23 km daily transportation of waste.

7.6.4 Energy Use

Municipal electricity consumption from grid sources remains high, building and streetlighting account for 50% of local emissions. An additional 85 solar streetlights installed in 2023 offset a fraction of grid demand.

7.7 Impacts

7.7.1 Air Quality Impacts

- Negative: Elevated particulate matter from traffic and construction; odours from landfill sites degrade urban air.
- Positive: Indirect improvements via 15.6% recycling rate and 6% overall waste generation reduction.

7.7.2 Greenhouse Gas Emissions

- Negative: Methane from Matsapha landfill, transport CO_2 from daily waste trips, and energy sector UFI.
- Positive: Solar streetlights cut local electricity-related emissions.

7.7.3 Climate Change Impacts

- Water Resources: E. coli contamination in Cuddle Puddle and rivers prompts boil-water advisories.
- Heat Stress and Public Health: Rising temperatures increase heat-related morbidity; municipal health inspections rose to 158 in 2021/22.
- Infrastructure: Flooding risks on Mpumalanga Road and Umdoni drainage demand climate-resilient designs.

7.7.4 Ecosystem Health

Invasive alien species along the MR103 threaten native biodiversity; control program in 2022 removed Mexican sunflower stands.

7.8 Responses and Mitigation Measures

These include:

- Waste Management: Pilot waste-separation program in Ward 4 achieved 11.8% diversion in March 2024; aims 30% by 2025.
- Renewable Energy: Installation of an additional 85 solar streetlights and plans for municipal rooftop solar.
- Disaster Preparedness: Completed three-volume Disaster Risk Management Plan identifying air pollution, flooding, fire, hail, and infrastructure failures as top hazards; annual drills mandated.
- Policy and Bylaws: Drafted 11 environmental Bylaws for local air, noise, and waste control, pending promulgation.

- Infrastructure Adaptation: Upgraded Ligugu and Mpumalanga roads with drainage resilience; invested E8.45 million in 2019/204.
- Environmental Monitoring: Routine food-safety, water-quality, and construction-site inspections; health and environment team increased to five officers by 2024.

7.9 Critical Gaps

These include:

- Monitoring Infrastructure: No direct $PM_{2.5}$/PM_{10} or NO_2 monitoring stations; reliance on indirect proxies limits data.
- Laboratory Capacity: Absence of in-town laboratory results in 2-week delays in water and food testing.
- Human Resources: Only two dedicated environment inspectors; disaster unit staffed temporarily.
- Waste Disposal: No local disposal or materials-recovery facility; 23 km transportation to Matsapha landfill increase costs and emissions.

7.10. Recommendations

These include:

- Air Quality Monitoring Network: Install three monitoring stations for $PM_{2.5}$, PM_{10}, NO_2, and O_3 for real-time data and alerts.
- Municipal Laboratory: Establish basic lab capabilities for water, food, and air sampling with rapid turnaround.
- Expand Waste-Separation: Scale pilot across all wards, targeting 30% landfill diversion by 2025 and focus on other streams of recyclables such as organic waste.
- Renewable Energy Scaling: Complete solar streetlighting network and pilot rooftop PV on municipal buildings.
- Strengthen Human Resources: Recruit additional environment and SHEQ officers; develop disaster-management careers.
- Local Disposal Facility: Secure land and develop materials-recovery and composting facility to cut transport emissions.
- Policy Enforcement: Gazette and enforce environmental Bylaws; conduct regular audits with penalties for non-compliance.

7.11 Conclusion

Ezulwini exhibits both progress and persistent challenges. Waste recycling, solar energy adoption, and robust disaster planning have stabilized some risks. However, air quality remains unconstrained by direct monitoring, and greenhouse gas emissions

continue from transporting waste to Matsapha. The state is **stagnant**: targeted investments in monitoring, local facilities, and human resources are crucial to catalyze an improving trajectory. Effective implementation of the above recommendations will position Ezulwini toward a resilient, low-carbon, and health-secure future.

Chapter 8: Public Health and Safety

"The greatest wealth is health." – United Nations

8.1 Overview

Ezulwini's public health shows signs of **improvement** in sanitation coverage and healthcare access yet remains **stagnant** in disease surveillance and environmental monitoring. Waste diversion rose to 11.8 % through source-separation pilots, and vaccination outreach reached underserved areas. However, waterborne disease tracking is non-existent, air quality remains unmonitored, and only two inspectors manage environmental compliance. Key pressures include population growth, peri-urban waste influx, and climate variability. Driving forces are strong municipal policies, community engagement via AGMs, and international partnerships (UNDP, JICA). Impacts of current programs include reduced landfill loads (+ 8 % recycling) and enhanced community resilience; negative impacts persist as illegal dumping and data gaps. Responses have encompassed Bylaws drafting, disaster planning, and lab testing protocols. Gaps involve absence of real-time monitoring labs and calibrated air pollution stations. Recommendations urge establishment of surveillance systems, lab and air sensors, capacity building, and acceleration of Bylaws promulgation.

8.1.1 Background and Context

National and international frameworks guide Ezulwini's public health strategies. At the national level, the Health Act (2023) mandates sanitation and disease control. The Environmental Management Act (2002) underpins pollution prevention, while the Urban Government Act (1969) empowers municipal Bylaws development. The Ministry of Health's National Health Sector Strategic Plan II focuses on health system strengthening and human capital development. Internationally, Eswatini aligns with the Sustainable Development Goals (especially SDG 3, 6, and 11) and the New Urban Agenda for sustainable cities. Partnerships with UNDP, JICA, and WHO complement local efforts in laboratory capacity, waste management, and community resilience.

8.2 State of Public Health in Ezulwini

8.2.1 Incidence of Waterborne Diseases

Despite extensive water quality monitoring, specific waterborne disease incidence data remains limited. Hospital records focus on general gastrointestinal complaints rather than confirmed waterborne pathogen identification. This represents a critical data gap that hampers effective public health response and prevention strategies. According to a survey under the study, the incidence of waterborne diseases remains relatively low, with only 3.6% of surveyed urban households reporting experiencing such illnesses in the past year (Figure 35). This suggests that while contamination exists in natural water sources, the municipal water treatment and supply system is effectively protecting most residents from waterborne pathogens.

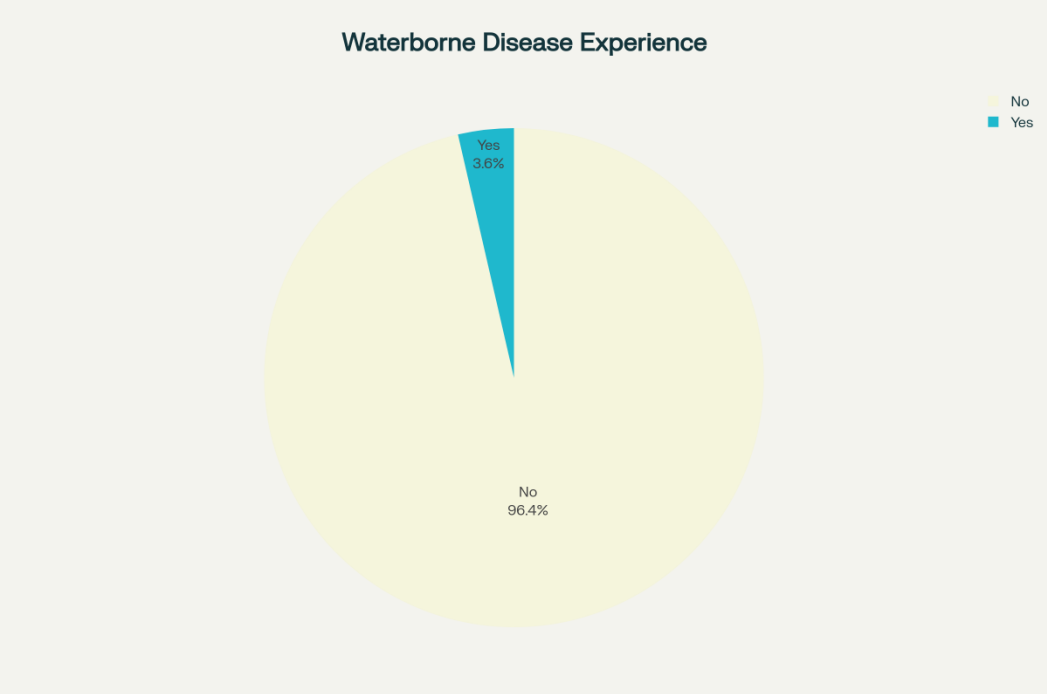

Figure 35: Experience of Waterborne Diseases in Ezulwini Households

Infrastructure upgrades include the installation of new water kiosks and treatment plants to improve access, yet water samples submitted for testing face delays of two to three weeks before actionable results are available.

8.2.2 Air Pollution (Related Health Issues)

Eswatini's national average for fine particulate matter (PM2.5) is 17 µg/m³, surpassing the World Health Organization guideline of 10 µg/m³, but Ezulwini has no municipal air quality monitoring stations to confirm local levels. Limited data show reported cases of asthma and sinusitis, yet without local air monitoring, these health effects remain under-attributed to pollution. According to a survey done under this study, air pollution-related health issues in Ezulwini include asthma (reported by 15 respondents), sinusitis (5 respondents), and exposure to second-hand smoke (4 respondents). However, a significant number of respondents (15) indicated that air pollution health issues were "not applicable" to them, suggesting relatively good air quality compared to more industrialized areas. The Municipality has implemented environmental programs including the planting of 750 indigenous trees and invasive species control along the MR103 highway. These initiatives aim to improve air quality and environmental health, though their impact has not been systematically measured.

8.2.3 Healthcare Accessibility

Ezulwini Municipality maintains seven primary healthcare facilities serving the urban population: Medisun Clinic, Clicks Pharmacy, Ezulwini Pharmacy, LinkedMed Pharmacy, Artemis, Ezulwini Private Hospital, and Ezulwini Clinical Laboratory Services. These facilities provide comprehensive medical services including emergency care, pharmaceutical services, and diagnostic capabilities. Significant community health initiatives include rabies vaccination campaigns reaching 78 dogs and 1 cat in

2022/23. Mobile health services expanded through partnerships with organizations like the Eswatini Breast and Cervical Cancer Network, providing free cancer screenings. Home-based care visits totalled 376 in 2023/24, demonstrating robust community health support systems. Healthcare accessibility in Ezulwini is rated highly by residents, with 81.9% of survey respondents giving the highest rating of 5, indicating excellent accessibility (Figure 36). This positive perception is supported by the presence of healthcare facilities including Neighbourhood Care Points (NCPs) and mobile clinic services.

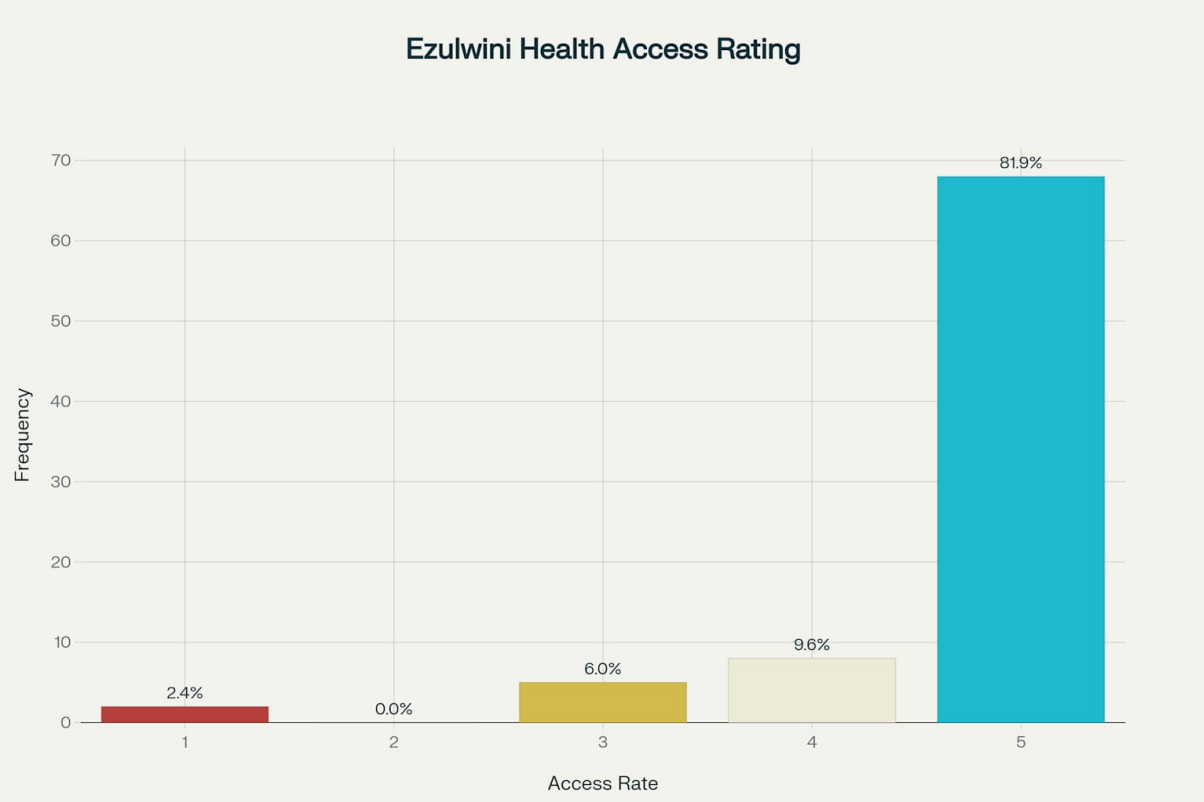

Figure 36: Healthcare Accessibility Rating in Ezulwini

8.2.4 Healthcare Infrastructure

Ezulwini benefits from its proximity to national healthcare facilities, including government hospitals that offer comprehensive services ranging from basic medical care to specialized treatments. The Municipality has also implemented preventive healthcare programs including COVID-19 vaccination drives, cancer screening clinics, and home-based care visits.

8.2.5 Sanitation Coverage

The Public Health and Environment Department collected 2,206,564 kilograms of municipal solid waste in fiscal year 2022–23, with the recycling rate improving from 6.7% to 15.7%. A pilot waste-separation program in Ward 4, responsible for 47% of the town's waste, achieved an increase in landfill-diversion rate by March 2024, effectively halving disposal costs at the Matsapha landfill. Compliance activities included 112 routine inspections of food establishments and issuance of 33 health-

clearance certificates, a 37.5% year-on-year increase demonstrating strengthened regulatory oversight.

8.2.6 Health and Safety Incidences

The Municipality maintains rigorous food safety oversight through systematic inspection programs. Figure 37 shows that routine inspections peaked at 164 in 2022/23, with comprehensive food outlet grading ensuring public health protection.

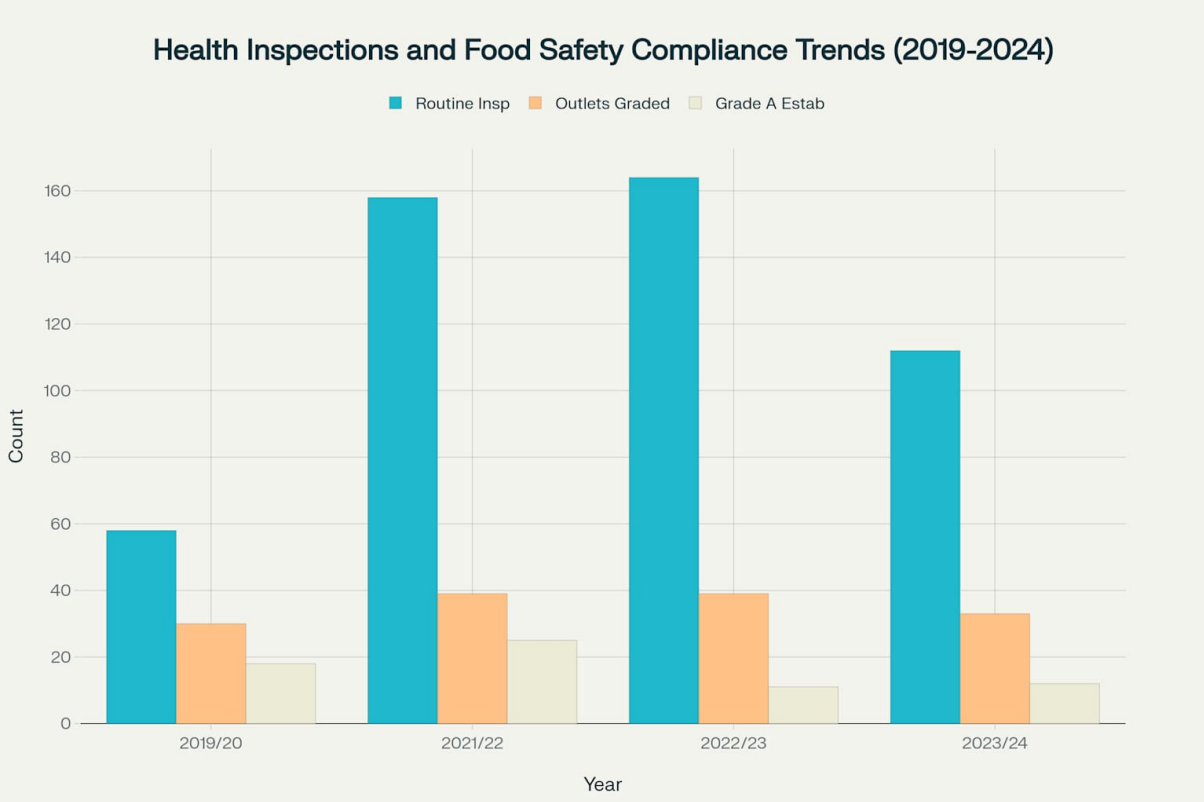

Figure 37: Health inspections and food safety compliance trends in Ezulwini Municipality from 2019-2024

Food safety compliance shows variable performance, with Grade A establishments (achieving 90% or higher compliance) fluctuating from 60% in 2019/20 to 37% in 2023/24. Despite these variations, the Municipality condemned significant quantities of expired and damaged food items, including 9.3 tons in 2021/22 and 10.2 tons in 2022/23.

Construction project monitoring includes comprehensive health and safety assessments through Environmental Impact Assessment protocols. The Municipality conducts random depot inspections focusing on Personal Protective Equipment compliance and workplace safety standards. Fire emergency preparedness has been prioritized through the Disaster Risk Management Plan, with fire identified as a priority hazard requiring specialized monitoring and response capabilities.

The department managed 53 public health and environment complaints in 2022–23, addressing issues such as public nuisances, illegal dumping, and overgrown plots. A comprehensive Disaster Risk Management Plan was enacted, and the Municipality became the first to assess fire-hydrant functionality, revealing critical failures that

necessitate urgent collaboration with water services. Despite these hazards, no occupational safety incidents were reported among municipal staff, who also received cybersecurity training to mitigate emerging digital risks.

Healthcare waste management operates through a regulated system requiring monthly reporting from medical facilities. Medical facilities contract disposal services directly with authorized facilities like Matsapha, which operates an incinerator for safe healthcare waste disposal. Monthly documentation of waste types and quantities is enforced to ensure compliance to proper tracking and disposal protocols.

8.3 Key Driving Forces and Pressures

8.3.1 Urbanization and Development

Rapid urbanization and development in Ezulwini create pressure on public health infrastructure and services. The transformation from a primarily tourism-focused town to a commercial and residential hub has increased demands on water, sanitation, and healthcare systems.

8.3.2 Economic Factors

Economic disparities within Ezulwini contribute to health inequities, with peri-urban areas facing greater challenges in accessing clean water, adequate sanitation, and healthcare services. Tourism and commercial development provide economic opportunities but also create environmental pressures that impact public health.

8.3.3 Governance and Resource Constraints

Limited resources and capacity constraints affect the Municipality's ability to address public health challenges comprehensively. With only two environmental inspectors for the entire Municipality and delays in laboratory development for real-time water and food testing, monitoring and enforcement capabilities are limited.

8.4 Positive Impacts and Developments

8.4.1 Infrastructure Improvements

Significant investments in water and sanitation infrastructure have improved public health outcomes in Ezulwini. The Ezulwini Sustainable Water Supply and Sanitation Service Delivery Project has enhanced water access through 12 water kiosks in underserved areas and expanded the sewerage network.

8.4.2 Community Engagement

Community-based initiatives, including home-based care programs and health education campaigns, have positively impacted public health awareness and practices. The Municipality supports four Neighbourhood Care Points that provide basic healthcare, nutrition, and early childhood development services.

8.4.3 Waste Management Innovations

Innovations in waste management, including increased recycling rates and the Waste Separation at Source Program in Ward 4, have reduced environmental health

risks. Recycling rates have improved from 6.7% to 15.7%, with plans to achieve greater than 30% diversion by 2025.

8.5 Current Public Health Responses and Achievements

8.5.1 Sanitation and Waste Management

Ezulwini Municipality has made significant strides in sanitation infrastructure, with an estimated 99% coverage rate for safe toilet facilities. The Municipality has implemented innovative waste management programs that demonstrate measurable progress:

- Waste Collection Performance: Total waste collected reached 2,206,564 kg in 2022-2023, with recycling rates improving from 6.7% to 15.7% over the reporting period.
- Waste Separation Program: The pilot program in Ward 4 achieved increased landfill diversion by March 2024, with Ward 4 generating approximately 47% of total municipal waste.
- Health Clearance Compliance: The Municipality issued 33 health clearance certificates in 2022-2023, representing a 37.5% year-over-year increase, indicating improved compliance monitoring.

8.5.2 Healthcare Access and Services

Healthcare accessibility receives high ratings from residents, with 81.9% of survey respondents giving the highest rating of 5 for accessibility. The Municipality supports healthcare through multiple channels:

- Community Health Infrastructure: Four Neighbourhood Care Points (NCPs) provide basic healthcare, nutrition programs, and early childhood development services.
- Preventive Health Programs: COVID-19 vaccination drives, cancer screening clinics, and mobile health units serve the community.
- Home-Based Care: 376 home visits were conducted, covering health education on HIV/STIs and general wellness.

8.5.3 Food Safety and Public Health Compliance

The Municipality maintains robust food safety standards through systematic inspection and monitoring:

- Routine Inspections: Conducted 112 routine inspections for all food establishments, with non-compliant establishments receiving Notifications of Violation.
- Food Grading: 51 food establishments were inspected and graded, showing improvement in performance with more establishments achieving A grades.

- Health Clearance Certificates: Processing time maintained at 2-3 days to promote ease of doing business.

8.6 Critical Gaps in Public Health Management

8.6.1 Disease Surveillance and Data Systems

The most significant challenge across all public health indicators is the absence of systematic data collection and surveillance systems:

- Waterborne Disease Tracking: No pathogen-specific surveillance exists for waterborne illnesses, with hospital records capturing only general disease profiles without attribution to specific sources.
- Air Quality Monitoring: Complete absence of air quality monitoring systems, with annual reports lacking metrics on pollution levels or respiratory health outcomes.
- Integrated Health Information: Limited integration between hospital records and municipal health planning systems.

8.6.2 Water Quality and Safety Concerns

Despite infrastructure investments, water quality remains a persistent challenge:

- Contamination Issues: Recurrent faecal contamination (E. coli and Total Coliforms) detected in Cuddle Puddle Spring and Mkhondolwane River.
- Testing Delays: Current testing relies on external laboratories, causing 2–3-week delays of the results, limiting rapid response capabilities.
- Infrastructure Limitations: Most boreholes have been decommissioned, with remaining ones used primarily as backup sources.

8.6.3 Resource and Capacity Constraints

Significant limitations exist in human resources and infrastructure:

- Staffing Shortages: Only two environmental inspectors serve the entire Municipality, limiting compliance monitoring capacity.
- Laboratory Capabilities: No municipal laboratory for real-time testing of water, food, or environmental samples.
- Budget Limitations: Current budget only allows for reactive checking rather than proactive environmental health measures.

8.6.4 Environmental Health Monitoring

Critical gaps exist in environmental health surveillance:

- Air Pollution Assessment: PM2.5 levels average 17 µg/m³ nationally, exceeding WHO guidelines, but no local monitoring exists in Ezulwini.

- Hazardous Waste Management: No systematic separation of hazardous waste from general waste, with items like paint and electronics ending up in general disposal.
- Climate Adaptation: Limited systematic approach to addressing climate change impacts on public health Community Health Perspectives and Challenges

8.6.5 Survey Findings on Health Access and Quality

Community survey data reveals mixed perceptions of public health services 4:

- Healthcare Accessibility: 81.9% of respondents rated healthcare accessibility as excellent (rating of 5).
- Air Pollution Health Issues: Low levels reported, with 15 respondents citing asthma, 5 citing sinusitis, and 4 reporting second-hand smoke exposure.
- Mental Health Concerns: Stress (20 respondents), depression (18 respondents), and anxiety (5 respondents) represent significant community health challenges.

8.6.6 Waterborne Disease Experience

Survey results indicate relatively low incidence of waterborne diseases, with only 3.6% of households reporting such illnesses in the past year. However, this may reflect under-reporting rather than absence of risk, given the documented water contamination issues.

8.6.7 Social Health Challenges

The survey reveals significant social pathologies affecting public health:

- Substance Abuse: Accounts for 71.4% of reported social pathologies
- Domestic Violence: Represents 23.8% of social pathology cases
- Mental Health: Chronic stress due to high cost of living emerges as a recurring theme

8.7 Recommendations for Ezulwini Public Health

Water Safety

- Establish rapid-testing laboratory for on-site microbiological and chemical water analysis to reduce delays and enable real-time interventions.
- Expand regular monitoring to include boreholes or groundwater sources, with data integrated into a centralized surveillance system.

Air Quality

- Install a network of municipal PM2.5 sensors at key locations and link real-time data to clinic admissions for respiratory conditions.
- Develop a public air-quality dashboard and conduct seasonal health impact assessments to guide mitigation.

Healthcare Access & Surveillance

- Conduct annual health surveys for Ezulwini
- Formalize partnerships with mobile clinic providers for sustained HIV, TB, and NCD screening outreach.
- Implement an integrated electronic health record system across Neighborhood Care Points to capture disease trends and enable early warning.

Sanitation & Waste Management

- Accelerate rollout of household waste separation to all wards, targeting ≥ 30 % recycling by 2026, supported by education campaigns and community buy-back centres in peri-urban areas.
- Procure land for a local disposal site and materials-recovery facility to cut transport costs, reduce illegal dumping, and manage health-care risk waste on-site.

Environmental Health & Safety

- Recruit two additional public-health/environmental inspectors and appoint a dedicated SHEQ officer to strengthen compliance monitoring.
- Institute mandatory annual fire-drill and hydrant-function audits for all commercial and high-risk facilities, with corrective plans enforced by the Disaster Risk Management Office.

Data & Governance

- Fast-track the promulgation of 11 municipal Bylaws (waste, water safety, public nuisance) to grant enforcement authority and permit local revenue from user fees.
- Develop an environmental-health dashboard integrating water testing, air-quality, waste composition, and disease surveillance data to support evidence-based planning.

Chapter 9: Social and Well-being and Cross-cutting Issues

Mental health is vital to humanity, allowing us to lead fulfilling lives and contribute fully to our communities. – United Nations

9.1 Overview

Over the past five years, the overall state of social well-being in Ezulwini has been **stagnant to mildly improving**. Quality of life ratings remain average, social cohesion and access to recreation are weak, mental health issues persist at high levels, and crime, particularly theft and domestic violence has begun to decline but remains significant. Driving forces include economic disparities, rapid urban development, and cultural norms. Pressures stem from service delivery gaps, youth unemployment, and infrastructure shortfalls. Positive impacts arise from growing private investment, community watch initiatives, and emerging wellness programs. Negative impacts include rising substance abuse, social isolation, and environmental stressors. Responses by the Municipality and stakeholders encompass new Bylaws, neighbourhood watch patrols, home-based care, and planned wellness strategies. Critical gaps exist in specialized mental health facilities, public recreational infrastructure, coordinated social services, and data-driven planning. Recommendations call for integrated mental health services, municipal recreational facilities, a unified social services framework, participatory budgeting, and strengthened monitoring and evaluation.

9.1.1 Applicable National & International Frameworks

- National Development Plan (NDP) 2023–2033: Emphasizes inclusive growth, health access, and community safety.
- Eswatini National Mental Health and Substance Abuse Strategy 2018–2023: Calls for community-based services and stigma reduction.
- Urban Government Act, 1969: Grants municipalities authority for Bylaws on public health, environment, and land use.
- Eswatini Vision 2022: Aims for improved quality of life and service delivery.
- Sustainable Development Goals (SDGs): Particularly SDG 3 (Good Health and Well-being), SDG 11 (Sustainable Cities), and SDG 16 (Peace, Justice, and Strong Institutions).
- New Urban Agenda (Habitat III): Advocates inclusive urban planning and resilient communities.

9.2 State of Social and Well-Being

9.2.1 Quality of Life

Most residents' rate life as average; only 15% rate it poor. Home-based care support and rising property values reflect moderate well-being, but unemployment and environmental concerns persist (Figure 37).

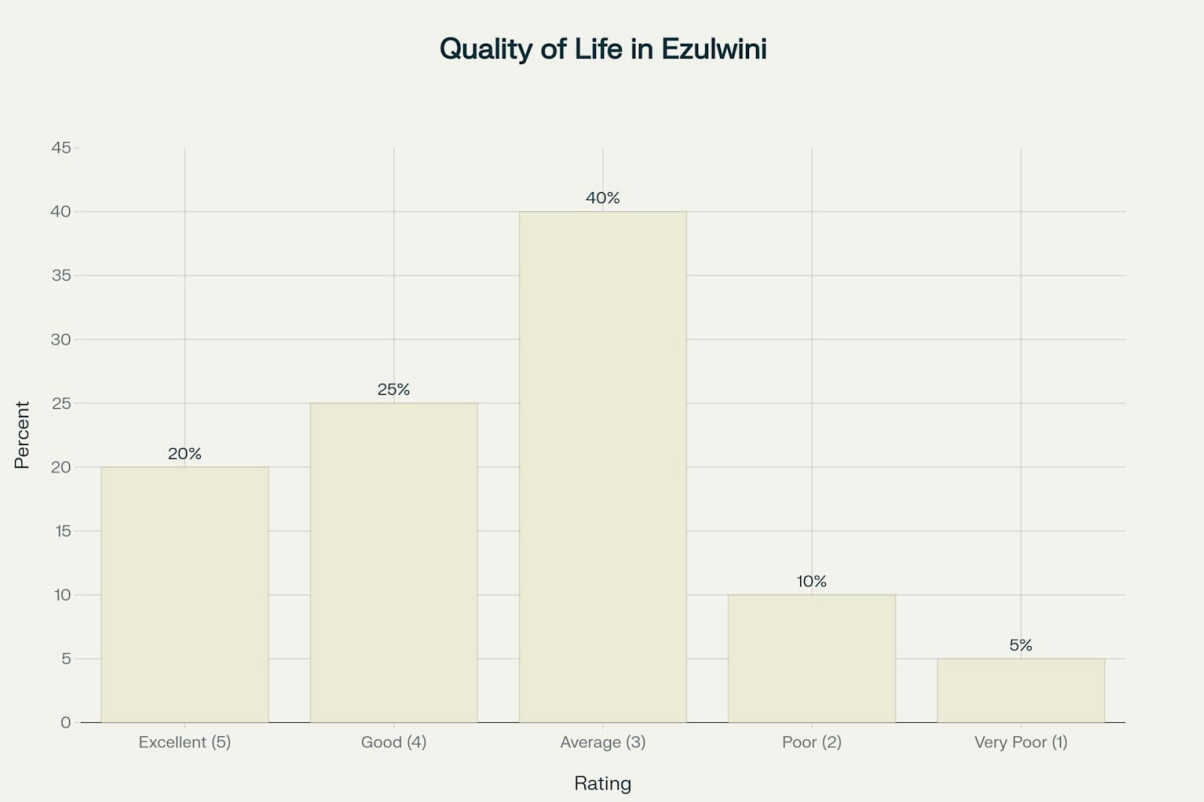

Figure 37: Overall quality of life ratings in Ezulwini

Several factors influence quality of life in Ezulwini, including economic conditions, access to services, and environmental factors. The Public Health and Environment Department works to improve quality of life through disease prevention and treatment, health promotion, and environmental management. However, challenges remain, particularly regarding unemployment, which has been identified as a critical driver affecting quality of life for some community members.

The Municipality has implemented limited social support initiatives, including the provision of home-based care items to households within the town. These localized support systems aim to provide emotional and physical assistance through counselling and essential care items such as adult diapers. Despite these efforts, there is a recognized shortage of social services, including mental health support, childcare, elderly care, and housing assistance.

9.2.2 Social Cohesion & Community Engagement

Only 35% of residents feel strong community bonds. Participation peaks around economic planning, with ward-based groups active; general event turnout and social media engagement remain low (Figure 38).

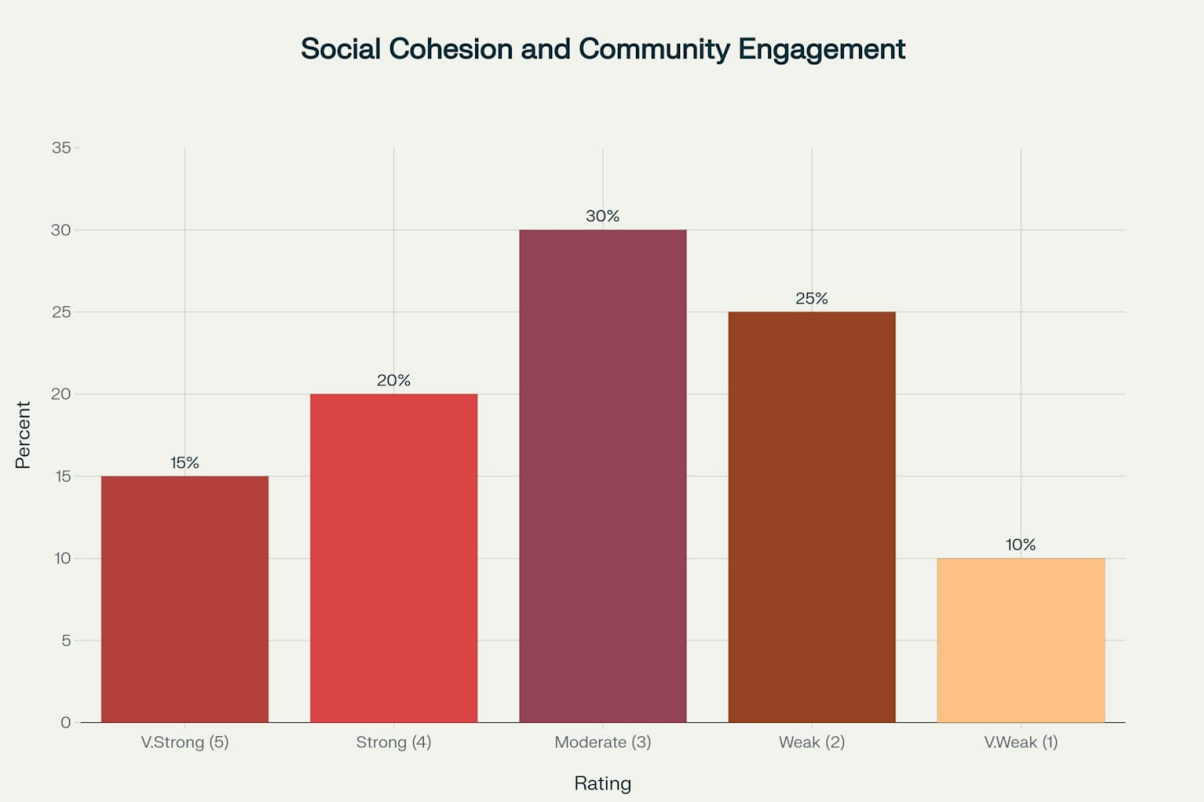

Figure 38: Social Cohesion and Community Engagement in Ezulwini

Community engagement varies depending on the type of activity. Participation is notably higher when it involves economic planning and the future development of the town, with residents forming ward-based groups to submit their inputs to the Municipality. However, general participation in community events and initiatives remains low, as does engagement through social media platforms. The benefits of stronger social cohesion include enhanced community resilience and more effective collective action. When communities work together on common goals such as neighbourhood improvement projects, health initiatives, or environmental conservation, they can address local challenges while fostering a sense of pride and shared responsibility. Youth engagement has been identified as one positive driver of social cohesion within the town. Economic inequality and segregation present significant pressures that threaten social cohesion. Limited access to resources for lower-income groups remains a challenge, even though the town might have a high overall standard of living. Plans to strengthen community engagement include developing public spaces within the town and providing free WiFi and other leisure-related services.

9.2.3 Access to Recreational Facilities

Half of residents rate recreational access as poor (Figure 39). No Municipal parks or gyms exist; reliance on private facilities risks exclusion of lower-income groups and limits youth programs.

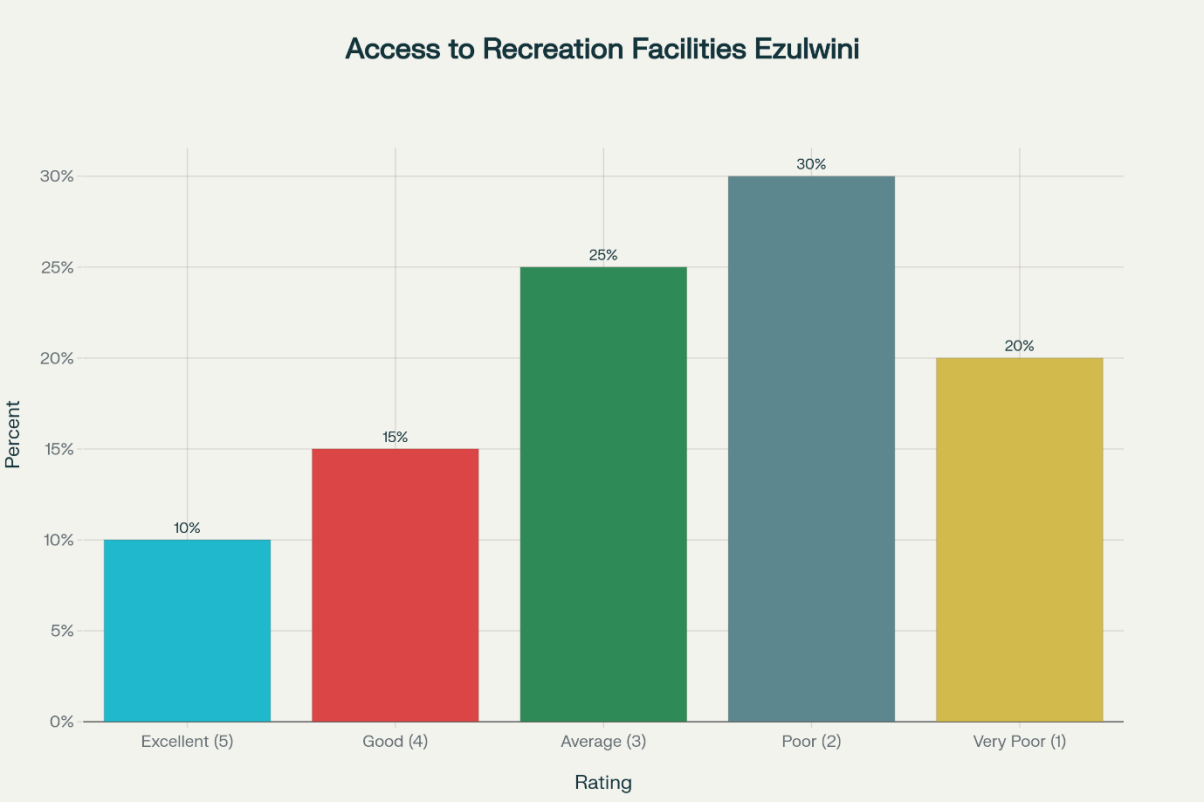

Figure 39: Access to Recreational Facilities in Ezulwini

Currently, Ezulwini Town does not have municipal recreational facilities, forcing residents and businesses to utilize privately owned facilities such as Cuddle Puddle, lodges, hotels, and Somhlolo stadium, which is located outside the municipal area. Even organizations based in the town that have wellness programs must resort to using Somhlolo stadium or other privately owned facilities.

The lack of recreational facilities has both positive and negative impacts on community well-being. While private facilities provide some exercise opportunities that help reduce the risk of chronic diseases such as heart disease, diabetes, and obesity, they may also inadvertently promote drug and substance abuse and inappropriate sexual activities among youth due to lack of structured recreational programs.

Urban layout significantly influences access to recreational facilities. Well-planned urban areas typically have parks, gyms, and sports facilities distributed evenly across neighbourhoods, ensuring relatively equal access for all residents regardless of income or location. The Municipality plans to address this gap by utilizing open spaces for parks and recreational activities, with implementation scheduled for the fiscal year 2025.

9.2.4 Mental Health & Well-Being

Mental health issues are prevalent in Ezulwini, with stress being the most common condition affecting 45% of residents. Depression affects 30% of the population, while anxiety impacts 15%. More severe conditions such as substance abuse (8%) and suicidal ideation (2%) are less common but still concerning (Figure 40).

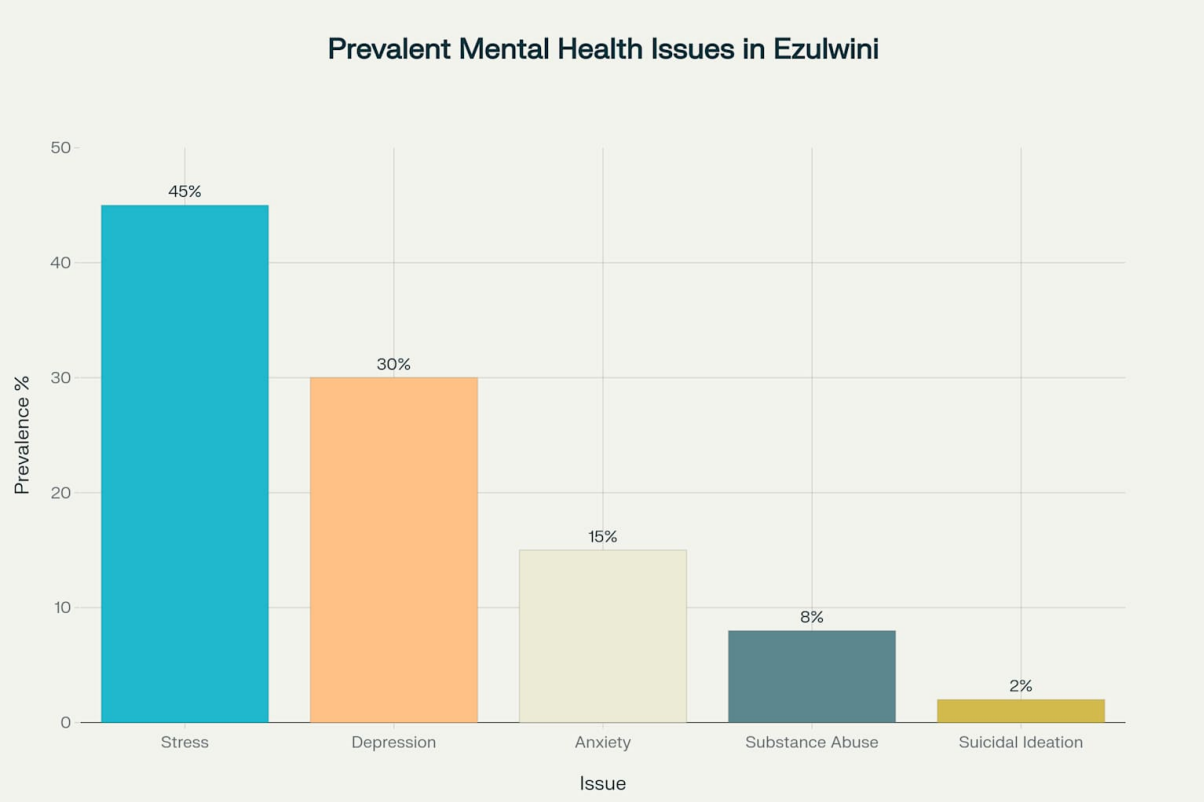

Figure 40: Prevalent Mental Health Issues in Ezulwini

The current mental health status in Ezulwini shows concerning trends, with cases requiring intervention reportedly on the rise. Substance abuse is increasing as people avoid arrests for drunk driving by turning to marijuana and other substances that are harder to detect. The town's reputation as home to elite and wealthy residents has made it a target for drug pushers, potentially worsening the mental health situation. Mental health issues significantly impact productivity and quality of life. Conditions like depression, anxiety, and chronic stress reduce residents' ability to focus and concentrate at work, leading to lower performance and increased likelihood of errors. Poor mental health affects all areas of life, including relationships, cognitive abilities, sleep, mood, appetite, and overall productivity.

Several factors influence mental health in Ezulwini. While residents generally have financial stability, the pressure to maintain a high standard of living creates significant stress. There may be pressure to succeed, achieve professional success, or keep up with social expectations. Stigma remains one of the most significant barriers to mental health care, with many people feeling ashamed or embarrassed to admit they are struggling, particularly in societies where success is highly valued. The Municipality plans to implement a comprehensive residential wellness plan in the coming fiscal year, which will be the first such initiative in the area. This plan aims to address the mental health needs of residents through various programs targeting different age groups and mental health concerns.

9.2.5 Crime Rates & Types

Theft (35%) and assault (25%) dominate. Domestic violence declined from 32 to 21 cases (2022–24), while youth-linked petty crime and external perpetrators remain a community concern (Figure 41).

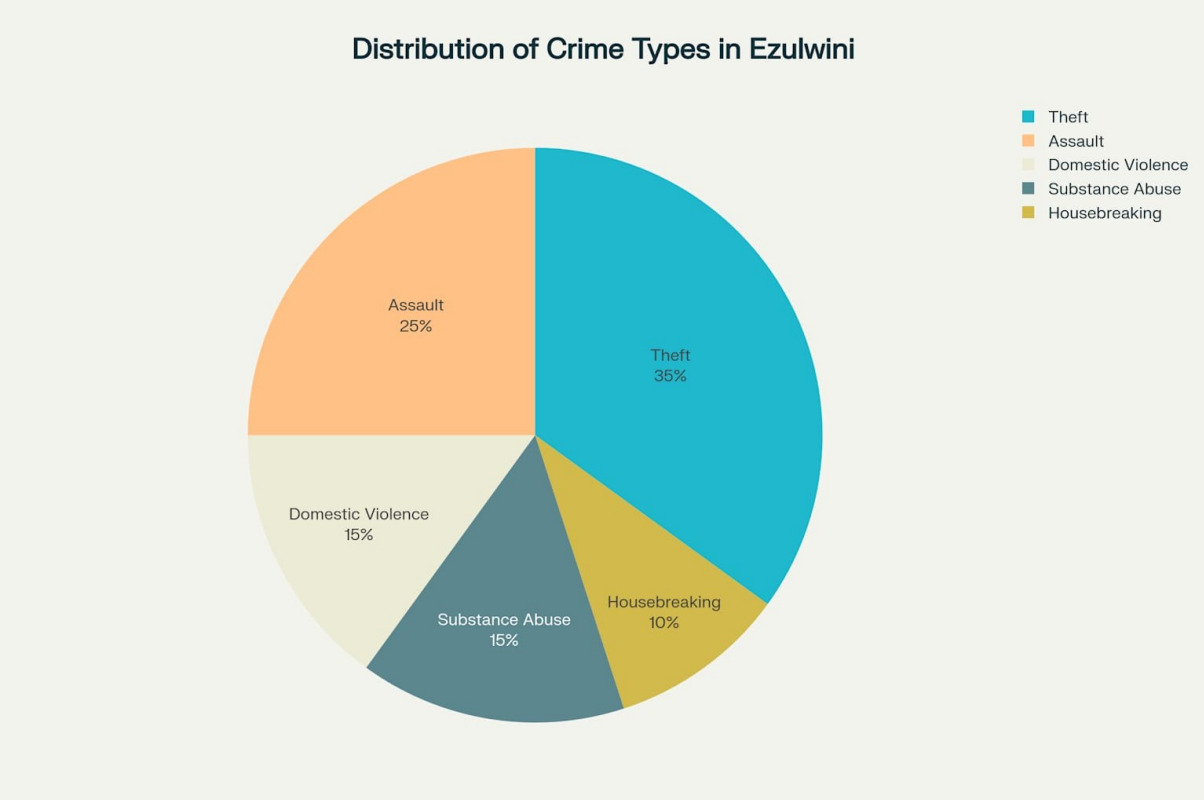

Figure 41: Distribution of Crime Types in Ezulwini

Domestic violence cases in Ezulwini have shown a positive declining trend over the past three years, decreasing from 32 cases in 2022 to 25 cases in 2023, and further down to 21 cases in 2024. This represents a 34% reduction over the three-year period, suggesting that interventions may be having a positive impact.

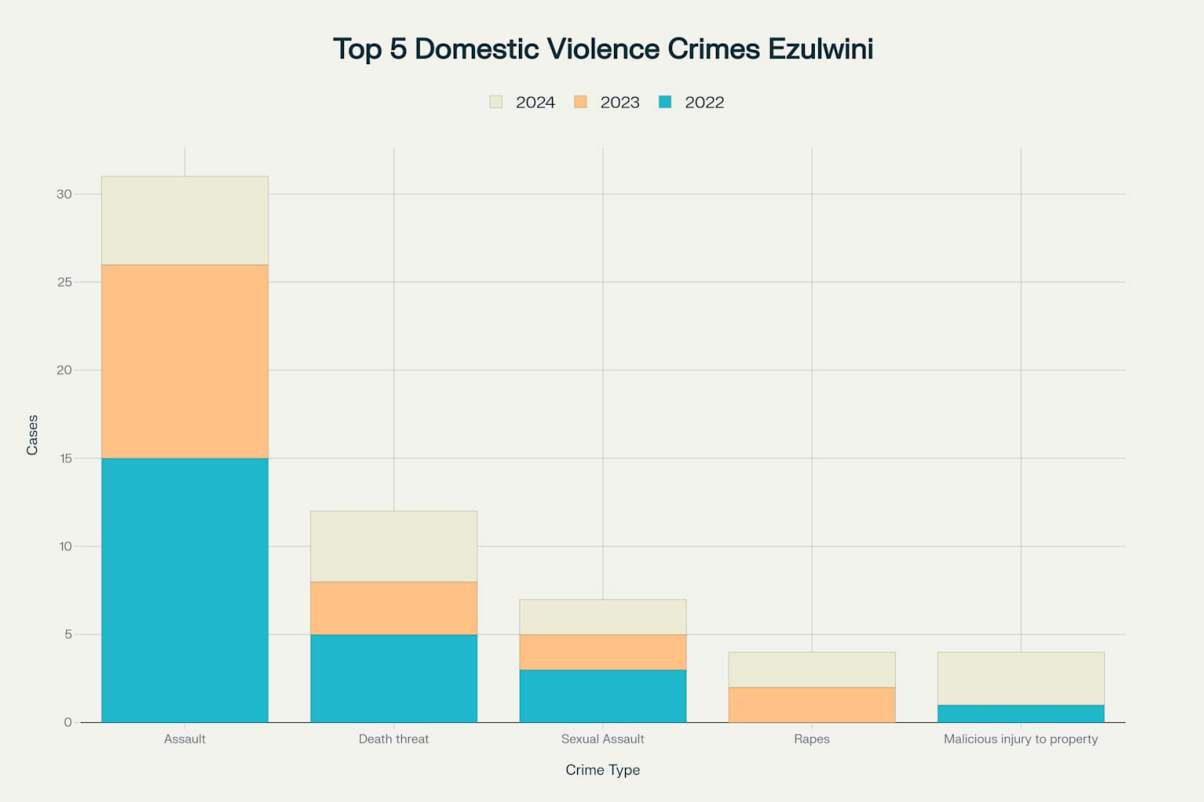

Figure 42: Top 5 Most Common Domestic Violence Crimes in Ezulwini (2022-2024)

Figure 42 shows the top 5 most common domestic violence crimes in Ezulwini since 2022, and Figure 43 breaks down the trends over time. Among domestic violence crimes, assault has consistently been the most common type, though it has shown a significant decline from 15 cases in 2022 to just 5 cases in 2024. Death threats have remained relatively stable (5 cases in 2022, 3 in 2023, and 4 in 2024), while sexual assault has slightly decreased (from 3 cases in 2022 to 2 cases in both 2023 and 2024). Rape cases increased from 0 in 2022 to 2 cases in both 2023 and 2024, and malicious injury to property fluctuated from 1 case in 2022 to 0 in 2023, then increased to 3 cases in 2024.

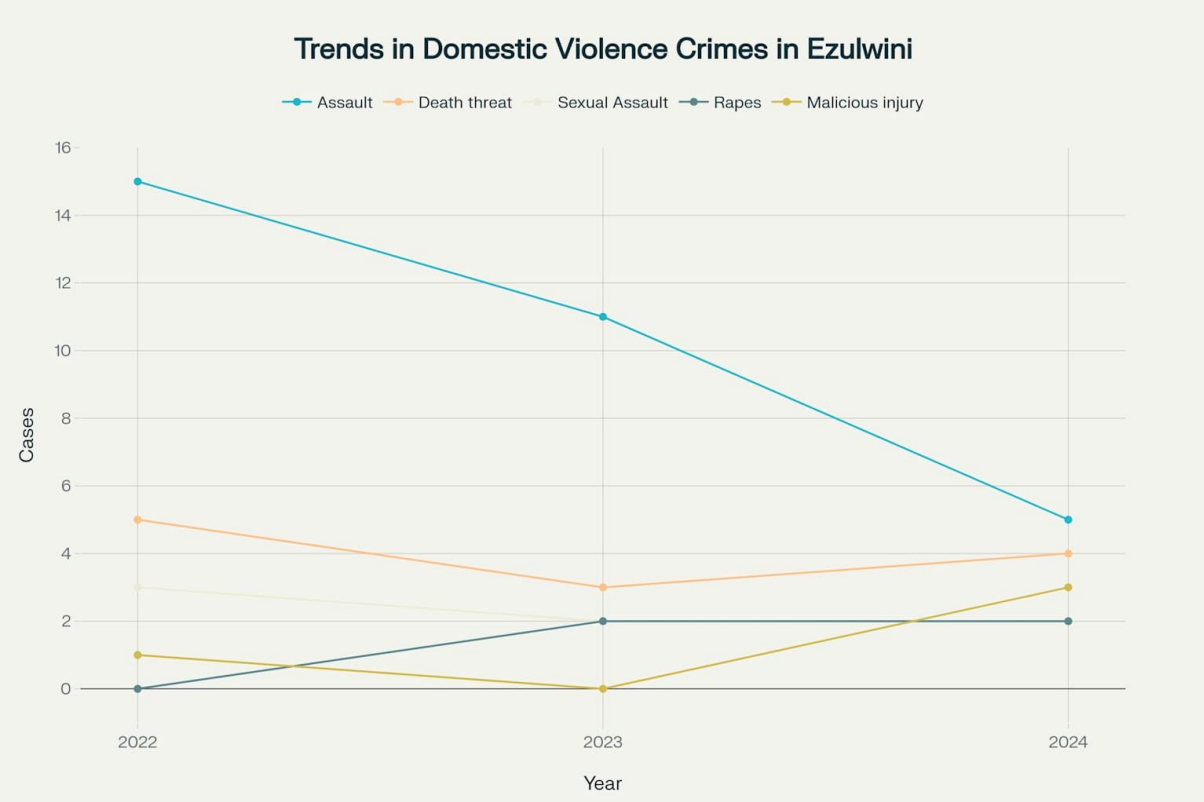

Figure 43: Trends in Domestic Violence Crimes in Ezulwini (2022-2024)

The economic disparity between the peri-urban and urban areas contributes significantly to the high crime rate within the town, with unemployment and lack of education identified as specific factors. Crime has been committed primarily by people from outside Ezulwini who target wealthy families, with some perpetrators coming from as far as South Africa. The rate has drastically reduced after the apprehension of key masterminds.

Crime prevention initiatives include street lighting, surveillance cameras, clearance of overgrown plots, and crime prevention lectures in schools and shops. The neighbourhood care watch, a resident-led initiative to eliminate crime, has been working closely with law enforcement and has contributed to improved safety. Plans include maximizing town lighting, implementing more crime response measures, and working collaboratively with the Umphakatsi (Traditional authority) to find solutions.

9.2.6 Social Pathologies

Substance abuse (40 %) and domestic violence (25%) prevail, followed by child neglect (15%) and youth crime (12%) (Figure 44). Transactional social interactions and parental absence exacerbate vulnerabilities.

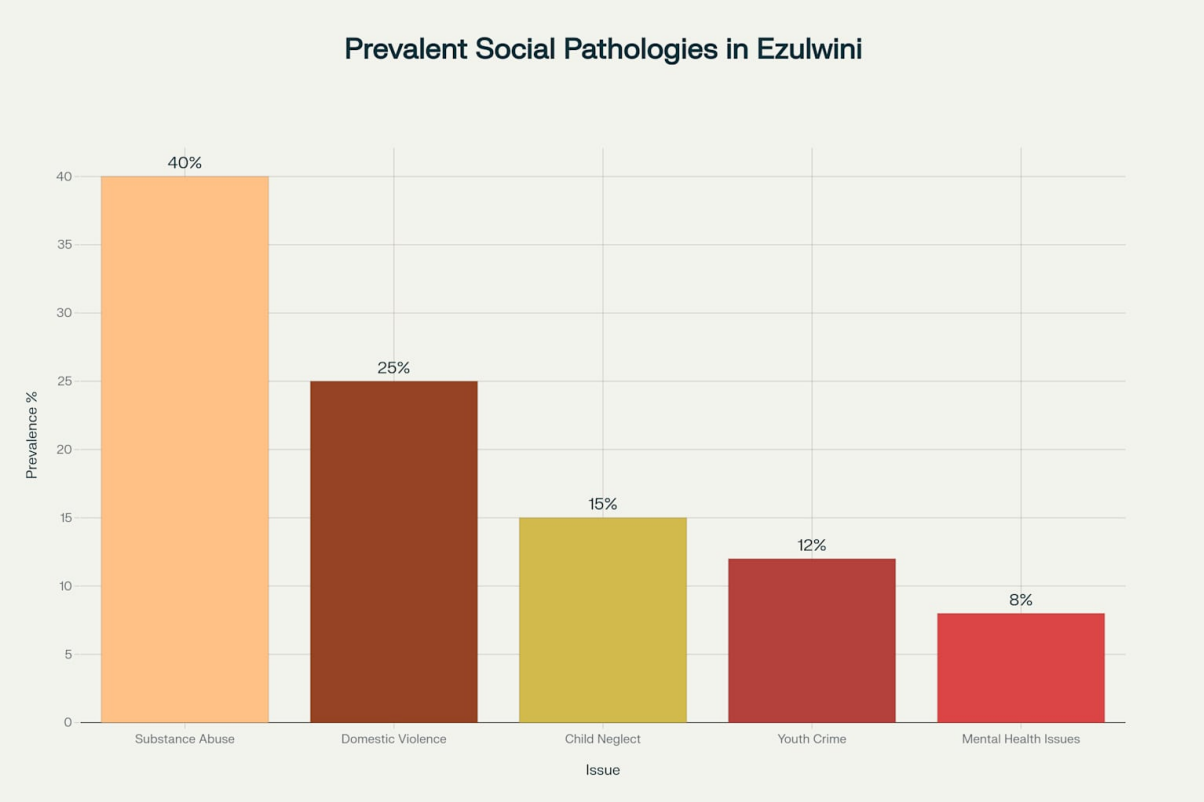

Figure 44: Prevalent Social Pathologies in Ezulwini

The prevalence of substance abuse has reportedly increased as people have resorted to using drugs to evade arrests for drunk driving. Youth have invented ways of avoiding alcohol detection by purchasing over-the-counter medicines and mixing them to produce intoxicating substances. This trend is particularly concerning given the town's status as a fashionable destination for high school students from around the country.

Social pathologies have profound impacts on family stability and community well-being. Domestic violence, while often underreported in wealthy communities, still occurs and can lead to severe emotional and psychological consequences, especially when hidden due to stigma. These issues create emotional distress, dysfunctional relationships, poor performance, and financial constraints due to poor financial decisions and medical complaints.

Social interactions in Ezulwini can sometimes be driven by status, leading to relationships that are more transactional than genuine. This creates a lack of authentic social support for individuals struggling with personal issues or social isolation. The Municipality plans to address these issues through a comprehensive wellness program that will identify specific problems and implement targeted interventions.

9.2.7 Cross Cutting Issues

The state of cross-cutting issues in Ezulwini reflects a community in transition, facing both opportunities and persistent challenges. Gender equality in environmental decision-making has improved, with women increasingly involved in leadership and planning, yet traditional norms and cultural barriers still limit full participation. Youth

involvement in environmental initiatives remains low, highlighting the need for targeted empowerment and engagement programs. Poverty continues to shape environmental outcomes, as limited access to resources, high unemployment, and inadequate infrastructure reinforce the link between socio-economic status and environmental vulnerability. Environmental education and awareness efforts are present but uneven, with polarized perceptions of their effectiveness and gaps in outreach, especially among marginalized groups. Finally, while HIV prevalence remains a concern, improved access to treatment has reduced its direct impact on environmental management, though uncertainty and stigma still hinder open discussion and data collection. Together, these issues underscore the importance of integrated, inclusive strategies to achieve sustainable development in Ezulwini.

9.3. Driving Forces & Pressures

9.3.1 Driving Forces

These include:

- Economic Disparities: Job concentration around high-income professionals drives unequal access and status-based stress.
- Rapid Urban Development: Private investment accelerates growth but outpaces municipal infrastructure planning.
- Cultural Norms: Transactional social ties and avoidance of mental health stigma influence behaviours.
- Geographic Positioning: Central location attracts commuters and external criminals.
- Economic transformation from tourism-based to commercial and corporate activities.
- National and municipal policies promoting poverty reduction, gender equality, and sustainable development.
- Infrastructure expansion

9.3.2 Pressures

These include:

- Service Delivery Gaps: Lack of public recreational facilities and mental health infrastructure strains community well-being.
- Youth Unemployment: Limited structured activities for youth fuels substance use and petty crime.
- Infrastructure Constraints: Insufficient drainage, street lighting, and waste facilities hinder liveability.

- Stigma & Awareness: Mental health and GBV underreporting impede intervention.
- Rapid population growth, urbanization, and rising demand for housing and services.
- Persistent poverty, unemployment, and widening socio-economic inequalities1.
- Environmental degradation, including loss of natural areas and increased pollution due to development and inadequate infrastructure.

9.4. Impacts

Table 9 summarizes the relevant impacts under the thematic area.

Table 9: Summary of relevant impacts

Type	***Positive Impacts***	***Negative Impacts***
Quality of Life	Home-based care reduces caregiver burden; property values attract investment.	Persistent unemployment, environmental stress, and housing costs amplify inequality.
Social Cohesion	Ward-based consultations boost participatory planning; youth groups offer engagement pathways.	Low general participation weakens social bonds, reducing collective efficacy.
Recreation	Private facility use promotes physical activity among those who can pay.	Economic exclusion from structured youth programs raises risk of drug use and antisocial conduct.
Mental Health	Planned residential wellness plan increases future support potential.	High untreated stress, depression, and substance use lower productivity and life satisfaction.
Crime	Neighborhood watch and patrols lower domestic violence and adult victimization.	External perpetrators and property crimes erode trust, heighten fear, and increase security costs.
Social Pathologies	Increased awareness via planned GBV campaigns may spur reporting and support seeking.	Substance misuse, domestic violence, and youth crime disrupt families and intergenerational stability.
Cross cutting issues		• Strain on municipal resources, limited-service delivery, and increased social challenges such as crime and drug abuse. • Uneven access to opportunities and services for women, youth, and vulnerable groups. • Ongoing environmental challenges, including loss of green spaces, flooding, and reduced effectiveness of environmental management.

9.4 Responses

These include:

- Municipal Bylaws: Drafted 11 environmental, public health, and user-fee Bylaws for local enforcement.
- Neighbourhood Watch & Armed Patrols: Collaborations with stakeholders reduced housebreaking and assault cases.
- Waste Separation & Characterization: Piloted source segregation and waste composition surveys reduced landfill volumes by ~40 %.
- Home-Based Care & Social Centres: AMICAAL-supported home visits and four Social Centres serve 122 children and 146 elderly.
- Crime Prevention Lectures & Street Lighting: Awareness sessions in schools and upgraded streetlights deter crime.
- Youth Entrepreneurship & Cooperative: UNDP-supported artisan training and co-operative formation empowered 100+ youth.
- Mental Health Planning: Residential wellness plan scheduled for fiscal year 2025 will introduce structured counselling and stigma reduction.

9.5 Critical Gaps

These include:

- Mental Health Infrastructure: No specialized clinics; shortage of professionals delay early intervention.
- Recreational Facilities: Absence of public parks or youth centres limits healthy engagement.
- Social Services Coordination: Fragmented delivery and lack of shared data hamper efficient support.
- Data & Monitoring: No baseline surveys on key indicators; limited routine assessments impede evidence-based planning.
- Community Inclusion: Vulnerable groups underrepresented in planning and stakeholder forums.

9.6 Recommendations

a) Develop Comprehensive Mental Health Services

    - Establish municipal clinic with psychologists, counsellors, and psychiatrists.
    - Launch anti-stigma campaigns and integrate mental health into primary care.

b) Invest in Public Recreational Infrastructure
    - Allocate land and funds for parks, sports fields, and youth centres.
    - Form public-private partnerships to manage facilities affordably.

c) Implement an Integrated Social Services Framework
    - Create a single referral system and case-management approach for vulnerable families.
    - Develop a Social Services Information System to track outcomes and resource needs.

d) Enhance Community Engagement & Inclusion
    - Use participatory budgeting to involve residents in allocating funds for social and recreational projects.
    - Establish advisory committees representing youth, women, elderly, and disabled groups.

e) Strengthen Data Collection & Monitoring
    - Conduct baseline and periodic surveys on all well-being indicators.
    - Integrate municipal data with national systems for timely analysis and reporting.

f) Scale Waste & Environmental Management Innovations
    - Replicate Buka pilot in peri-urban areas for source segregation buy-back.
    - Secure land for a municipal landfill and materials-recovery facility to reduce costs and environmental impact.

g) Integrate poverty reduction with environmental management and expand environmental education.

h) Improve infrastructure and service delivery for vulnerable groups.

i) Mainstream health considerations, including HIV, into development and environmental planning.

9.7 Conclusion

Ezulwini's social and well-being profile shows pockets of resilience alongside persistent challenges. Quality of life remains adequate but unequal; social cohesion and recreational access are weak; mental health and social pathologies are high, while crime trends show mild improvement. Existing responses demonstrate municipal initiative and community partnership but leave critical gaps in infrastructure, service coordination, and data-driven governance. Improving reliable baselines, expanding public amenities, integrating social and health services, and empowering residents

through inclusive planning will transform stagnation into sustainable progress. By aligning local action with national and international frameworks, Ezulwini can enhance resilience, equity, and overall well-being for all its citizens.

Chapter 10: Culture and Heritage

"Our culture is the glue that binds our society together and enables each and every Swazi to know their place in society." King Mswati III

10.1 Overview

The state of culture and heritage in Ezulwini is currently **stagnating**, with incremental policy developments counterbalanced by ongoing losses of traditional knowledge and site degradation. While new strategies and legal frameworks have been adopted, pressures from urbanization and globalization threaten both tangible monuments and intangible practices. Professional stakeholders have responded with inventories, capacity-building workshops, and pilot conservation projects, yet critical gaps, most notably in documentation, enforcement, and community participation remain. Unless addressed through targeted funding and institutional strengthening, the trajectory will continue to hover between modest improvement and further stagnation.

10.1.1 National and International Context

Eswatini's cultural policy framework aligns with multiple international instruments. The country ratified the UNESCO Convention for the Safeguarding of Intangible Cultural Heritage (2003) and the Convention on the Protection and Promotion of the Diversity of Cultural Expressions (2005), underscoring commitments to protect and celebrate intangible and expressive culture. Regionally, Eswatini is party to the SADC Protocol on Culture, Information and Sport (2001) and the African Charter on Human and Peoples' Rights (1968), which guarantee cultural rights and encourage cross-border cultural cooperation. Nationally, the Eswatini National Arts and Culture Policy (2023–2028) establishes guidelines for preserving languages, monuments, and living heritage, and mandates the creation of a National Arts and Culture Trust Fund to finance cultural initiatives. The Eswatini National Trust Commission (under the Ministry of Tourism and Environmental Affairs) serves as the primary regulatory body, coordinating heritage inventories and monitoring cultural sites.

10.2 Cultural Sites and Monuments Inventory

Table 10 presents an inventory of significant cultural sites and monuments within Ezulwini Municipality, detailing their preservation status based on information from municipal reports.

Table 10: Cultural sites and monuments in Ezulwini

Name of Site/Monument	Location	Type	Historical/Cultural Significance	Preservation Status
Mantenga Nature Reserve	Ward 6	Natural Heritage Site with Cultural Significance	725-hectare reserve showcasing traditional Swazi lifestyles; contains Mantenga Falls and Cultural Village with traditional performances and beehive huts	Good - Maintained as a protected area with active tourism management; key access point (Ligugu Street) upgraded with walkways and solar streetlights in 2023
Mantenga Falls	Within Mantenga Nature Reserve	Natural Heritage	One of the highest waterfalls in Eswatini; holds cultural significance for traditional ceremonies and rituals	Good - Protected within the nature reserve; accessible via maintained trails
Mantenga Cultural Village	Within Mantenga Nature Reserve	Cultural Heritage	Provides immersive experience of traditional Swazi lifestyle; features reconstructed beehive huts and resident dance troupe	Good - Actively maintained as the only tourist facility in Eswatini with a permanent traditional dance troupe; offers twice-daily performances
Hot Springs	Ezulwini	Natural Heritage with Cultural Significance	Thermal springs traditionally used for medicinal/healing purposes and cultural/spiritual rituals; community gathering place	Fair - Divided into formal (developed for tourism) and informal sections; informal section faces management challenges and potential environmental degradation
Iron Bridge	Across Lusushwana River	Built Heritage	Constructed by the Reilley family; served as vital connection point to Lobamba traditional headquarters; reportedly functioned as Eswatini's only tollgate in early history	Fair to Poor - Mentioned as having inadequate documentation and preservation approaches; specific condition not detailed
Muir's Hotel and Bar (KaMchoza)	Along MR103 (central Ezulwini)	Built Heritage	Historical establishment that has witnessed Ezulwini's evolution from traditional settlement to tourism hub; cultural gathering place	Undocumented - No specific information on preservation status provided

Ezulwini Hot Springs	Central Ezulwini	Natural Heritage	Thermal springs with traditional medicinal uses and cultural significance	Fair - Divided between formalized spa development and informal "Cuddle Puddle" area; management challenges noted regarding balancing visitor access with conservation needs

10.3 Discussion on Preservation Status and Challenges

10.3.1 Documentation and Inventory Management

One of the most significant challenges facing Ezulwini's cultural heritage is the inadequate documentation of sites and monuments. Municipal reports indicate "improper documentation of heritage sites, resulting in potential loss of historical information and inconsistent preservation approaches." This documentation gap threatens the long-term preservation of cultural knowledge and hampers the development of effective conservation strategies. Without comprehensive records, many sites like the Iron Bridge lack proper historical context and preservation guidelines.

10.3.2 Site Protection and Demarcation

The reports highlight critical issues in the physical protection and demarcation of heritage sites. There is "inadequate demarcation of heritage sites, with traditional boundary markers like 'peregun' being replaced by modern fencing in some areas but absent in others." This inconsistent approach creates vulnerability to encroachment and unauthorized development. The Hot Springs area demonstrates this challenge, with a division between formalized tourism facilities and informal traditional usage areas that require different management approaches.

10.3.3 Cultural Value and Modern Development

The Municipality face tensions between preserving cultural authenticity and facilitating economic development. There are concerns about the town gradually losing its identity as a tourist town due to the construction of office parks and shopping centres. This urbanization pressure has led to a diminishing value placed on heritage sites due to urbanization and the influence of modern entertainment alternatives. Sites like Mantenga Cultural Village represent successful models of cultural heritage tourism, but maintaining the balance between authentic cultural representation and commercial viability remains challenging.

10.3.4 Conservation Initiatives

Despite these challenges, several conservation initiatives are underway. The upgrade of Ligugu Street in Ward 6, which serves as a key access point to Mantenga Cultural Village and Mantenga Waterfall, demonstrates infrastructure development that

supports heritage site accessibility. The development of a Regional Open Space System (ROSS) integrates natural and cultural heritage conservation, recognizing their interconnectedness in Swazi cultural identity.

10.3.5 Community Engagement

There is limited systematic community engagement in heritage management decision-making. While stakeholder engagement is evident in various projects, there is a gap in specifically involving traditional knowledge holders and cultural practitioners in heritage conservation planning. The University of Eswatini partnership to develop public open spaces represents a positive step toward collaborative approaches to heritage space activation, but more targeted involvement of cultural knowledge keepers is needed.

10.4 Traditional Practices and Knowledge

10.4.1 Traditional Knowledge Systems

The preservation of traditional knowledge remains a critical aspect of cultural heritage in Ezulwini. Key traditional knowledge systems include:

- Traditional medicinal knowledge, which continues to be practiced alongside modern healthcare, with specific plants being harvested from protected areas like the Mantenga Nature Reserve.
- Oral traditions and storytelling that transmit cultural values, historical narratives, and practical knowledge across generations.
- Traditional ecological knowledge that informs sustainable resource management practices and seasonal activities.

10.4.2 Traditional Crafts and Skills

Ezulwini serves as an important centre for traditional crafts that represent both cultural heritage and economic opportunities for local communities. Significant traditional crafts include:

- Handcraft production showcased at the Ezulwini Handcraft Market, where artisans create and sell traditional textiles, beadwork, wooden carvings, and pottery.
- Traditional building techniques demonstrated at the Mantenga Cultural Village, preserving architectural knowledge that has been passed down through generations.
- Basket weaving, which utilizes indigenous materials and techniques that reflect deep cultural knowledge and artistic expression.

Figure 45: Culture and Traditional Markets in Ezulwini

10.4.2 Traditional Practices

Several traditional practices continue to be observed in Ezulwini, connecting contemporary community life to ancestral customs. These include:

- Traditional dance forms that serve as both entertainment and vehicles for cultural expression and identity formation.
- Traditional food preparation methods, particularly those associated with ceremonial occasions and festivals.
- Apprenticeship systems where traditional knowledge is transmitted through "learning by doing" under the guidance of recognized knowledge holders.

10.4.3 Cultural Events and Participation

10.4.3.1 Major Cultural Ceremonies

Ezulwini's proximity to Lobamba, the traditional and spiritual capital of Eswatini, makes it a key location for experiencing major national ceremonies that attract significant participation.

10.4.3.2 Umhlanga (Reed Dance) Ceremony

The Umhlanga ceremony represents one of Eswatini's most significant cultural events, with participation levels that demonstrate the vitality of traditional practices. Key aspects include:

- Annual participation of up to 40,000 young women who gather reeds to present to the Queen Mother (Indlovukazi), making it one of Africa's largest cultural gatherings.
- Eight days of activities that include reed cutting, presentations, and celebratory dancing that reinforce cultural values and social cohesion.
- Significant tourist attendance, with research indicating that the ceremony attracts visitors from across Eswatini (21% of attendees) and internationally (78% of attendees), generating economic benefits for the local community.

10.4.3.3 Incwala Ceremony

The Incwala, often translated as the "Kingship Ceremony," represents another major cultural event with deep significance to Swazi identity. The ceremony:

- Takes place over multiple days following the full moon nearest the summer solstice, with participation from people across all regions of Eswatini.
- Involves key ritual figures including the King, Queen Mother, royalty, royal governors, chiefs, regiments, and the "bemanti" (water people).
- Features elaborate rituals including the collection of sacred water, gathering of lusekwane (sickle bush) branches, and ceremonial consumption of first fruits.

10.4.3.4 Marula (Buganu) Festival

The Marula Festival celebrates the harvest of the marula fruit and the production of traditional marula beer (buganu). This cultural event:

- Unites communities in song and dance, particularly women who are the traditional brewers of marula beer.
- Showcases traditional harvesting practices, brewing techniques, and cultural performances that highlight Eswatini's living heritage.
- Takes place annually between February and May, marking the seasonal cycle that has structured traditional life for generations.
- Features participation from individual women, regional regiments, corporate entities, organizations, and government institutions, demonstrating broad community engagement

10.4.4 Participation Trends

Research on cultural event participation in Ezulwini and surrounding areas reveals several important trends:

- Strong international interest, with visitors from South Africa (25%) and other international locations (53%) attending cultural events like the Umhlanga ceremony.

- High education levels among cultural event attendees, with 49.5% holding diplomas or first degrees and 25.5% having postgraduate qualifications, indicating the appeal of cultural heritage to educated audiences.
- Significant first-time attendance (79% of visitors), suggesting the potential for growth in cultural tourism if visitor experiences are positive.
- Varied transportation methods used to attend events, with 48% using personal cars, 23% using minibus taxis, and 22.5% arriving by bus, highlighting the importance of transportation infrastructure for cultural participation.

10.5 Heritage Conservation Efforts

10.5.1 Institutional Framework

The conservation of cultural heritage in Ezulwini operates within a multi-layered institutional framework that includes national, regional, and local entities6.

- The Eswatini National Trust Commission (ENTC) plays a leading role in managing protected areas like the Mantenga Nature Reserve and documenting cultural heritage sites.
- The Ministry of Tourism and Environmental Affairs provides policy guidance and support for heritage conservation initiatives.
- The Ezulwini Municipality incorporates heritage conservation into its planning frameworks, including the Town Planning Scheme and Integrated Development Plan.

10.5.2 Conservation Initiatives

Several conservation initiatives are currently underway to protect and promote Ezulwini's cultural heritage:

- The development of a Regional Open Space System (ROSS) that integrates natural and cultural heritage conservation, recognizing the interconnectedness of these elements in Swazi cultural identity
- The preparation of an Environmental Management Plan that categorizes open spaces and proposes appropriate conservation and utilization strategies.
- The conversion of passive open spaces into active green corridors that connect different parts of the town, promoting both ecological benefits and cultural recreational opportunities.

10.6 Documentation and Research

Documentation and research efforts are essential components of heritage conservation in Ezulwini:

- The Town Planning Scheme process has included comprehensive documentation of cultural and natural heritage sites within the municipal boundary.
- Research on traditional knowledge systems, particularly medicinal knowledge, is being conducted to ensure its preservation for future generations.
- Visitor spending studies at cultural events provide data that can inform sustainable heritage tourism development strategies.

10.7 Pressures and Driving Forces

Cultural heritage in Ezulwini faces multifaceted pressures.

- Urbanization & Land-Use Change: Rapid growth along the MR103 corridor has converted grasslands and historic farmsteads into commercial and residential developments, shrinking open spaces and degrading archaeological sites.
- Globalization & Media Influence: Western and pan-African media expose residents to external cultural forms, often at the expense of local languages and oral traditions, leading to intergenerational gaps in knowledge transfer.
- Economic Tourism Forces: Tourism growth has commodified performing arts and traditional crafts, with market demands shaping simplified or "staged" cultural performances.
- Environmental Stressors: Climate change and invasive species encroach on natural heritage sites, riparian zones and the Mantenga Nature Reserve altering traditional medicinal plant habitats and river-based rituals.

10.8 Impacts on Cultural Heritage

10.8.1 Positive Impacts

- Cultural Preservation and Revitalization
    - Tourism interest has incentivized the preservation and showcasing of traditional Swazi culture, as seen in the Mantenga Cultural Village.
    - Economic opportunities have enabled investment in the maintenance and restoration of cultural heritage sites.
    - Cultural performances for tourists have helped maintain traditional dance forms and music that might otherwise fade away.
- Economic Benefits and Opportunities
    - Cultural heritage tourism has created employment opportunities for local communities, particularly in the hospitality and craft sectors.
    - The Mantenga Lifestyle & Craft Centre, established as an aid project to boost the development of the Swazi handcraft market, has provided economic opportunities for local artisans.

- Revenue generated from cultural tourism can be reinvested in heritage conservation efforts.

10.8.2.1 Enhanced Cultural Pride and Identity

- The international recognition of Swati cultural heritage has strengthened local pride and cultural identity.
- The formalization of cultural heritage management has raised awareness about the importance of preserving traditional knowledge and practices
- Cultural exchange with visitors has encouraged local communities to value and maintain their unique traditions.

10.8.2 Negative Impacts

- Authenticity and Commodification Concerns
  - The commercialization of cultural practices for tourism can lead to their simplification or distortion to meet tourist expectations.
  - Traditional cultural elements are sometimes extracted and commodified for commercial purposes, often without proper context or respect for their original significance.
  - The pressure to perform culture for tourists can transform authentic cultural expressions into staged performances.
- Loss of Traditional Knowledge and Practices
  - The shift away from traditional livelihoods has reduced the practical application of traditional knowledge, leading to its gradual erosion.
  - Modern technology and readily available information online have drawn attention away from traditional practices and oral traditions.
  - The disconnect between younger generations and traditional knowledge holders has disrupted the transmission of cultural wisdom.
- Physical Impacts on Heritage Sites
  - Increased visitor numbers can lead to physical degradation of heritage sites through wear and tear.
  - Development pressures have resulted in the alteration or destruction of some heritage features.
  - The informal use of cultural sites, such as the hot springs, has led to management challenges and potential environmental degradation.

10.9 Case Studies

Case Study 1: Mantenga Cultural Village and Nature Reserve

The Mantenga Cultural Village exemplifies both the opportunities and challenges of cultural heritage management in a tourism context. As the only tourist facility in Eswatini with its own fully-fledged permanent troupe, it offers twice-daily performances that showcase traditional Swazi culture. While this has created a platform for preserving and presenting cultural practices, it also raises questions about authenticity and the transformation of living culture into a tourism product. The adjacent nature reserve further illustrates the interconnection between natural and cultural heritage, with conservation efforts supporting both environmental protection and cultural sustainability.

Recommendations

- Co-create and rotate authentic performance content with local elders and custodians to safeguard genuine Swazi traditions and engage visitors meaningfully.
- Establish a multi-stakeholder governance board including village troupe leaders, ENTC, environmental and tourism authorities to streamline decision-making and enforcement.
- Integrate eco-cultural experiences by linking reserve trails and guided tours to heritage performances while implementing visitor caps and reservation systems for sustainability.
- Share revenue with community development, support on-site artisan workshops, and conduct regular KPI-driven reviews to adapt programming and conservation efforts.

Case Study 2: Cuddle Puddle Hot Springs: Balancing Tradition and Development

Historical Context

The hot springs have historically served medicinal and spiritual roles for local communities and now function simultaneously as a heritage site and tourist attraction. Figure 46 shows the Cuddle Puddle.

Figure 46: Cuddle Puddle Pictures

Management Dynamics

The contrast between the formal spa development and the informal "Cuddle Puddle" highlights the tension between commercial enterprise and traditional communal access. Balancing visitor access with environmental conservation and cultural integrity remains a core management challenge as tourism potential expands.

Stakeholder Perspectives

- Property Owner: Warns of severe environmental and health hazards from decades of unregulated waste discharge into the Manzana River, bureaucratic barriers to basic infrastructure, and a collapse in tourism revenue; he proposes cultural tourism strategies including a live Swazi village, luxury rail links, and repurposing an unused convention centre to generate income.
- Chairperson of the Users: Underscores the springs' social and healing significance, advocates transforming the area into a secure community beach with amenities, gender-balanced access hours, and endorses partnerships based on community-led contracting and capacity-building through international site visits.
- Eswatini National Trust Commission (ENTC): Stresses the need for legal protection under heritage laws, buffer-zone enforcement, and integrated conservation planning, and calls for coordination with the Eswatini Environment Authority and Tourism Authority to achieve sustainable site development.

Recommendations for Cuddle Puddle Improvement

- Install gender-separated portable toilets and hand-washing stations and launch continuous upstream and downstream water-quality monitoring with public reporting to halt waste discharge into the Manzana River and ensure rapid contamination response.
- Establish a legally empowered multi-stakeholder board and implement a fast-track permitting process for essential infrastructure (sanitation, seating, lighting) to streamline management and eliminate bureaucratic delays.
- Formalize women's access hours (e.g., 9 a.m. – 2 p.m.), designate heritage zones for traditional healing and men's gatherings, and develop basic amenities (umbrellas, seating, barbecue areas) plus eco-friendly rental units through community-led contracting.
- Adopt a one-year pilot funding model with external partners investing upfront under community oversight and organize study tours to benchmark hot-spring management best practices and provide leadership training.
- Define quarterly KPIs for water-quality compliance, waste-collection effectiveness, visitor satisfaction, and local employment, and conduct biannual reviews to adjust strategies, regulations, and amenities based on performance data.

10.10 Responses

- Heritage Inventories: The Eswatini National Trust Commission has conducted national and regional inventories of tangible and intangible heritage, including a UNESCO-funded intangible heritage inventory in Shiselweni (2019–2022).
- Capacity-Building: Community workshops and training programmes sponsored by UNESCO and local NGOs have empowered traditional leaders, schoolteachers, and cultural practitioners to document and safeguard heritage.
- Policy Development: The new Arts and Culture Policy (2023–2028) introduces a National Arts and Culture Trust Fund, regulatory guidelines for cultural industries, and incentives for local content in broadcasting.
- Site Management: Pilot projects for waste separation and green corridor development around Mantenga Cultural Village aim to reduce environmental pressures on natural and cultural sites.

10.11 Critical Gaps

- Documentation Deficits: Many intangible practices and small heritage sites remain unrecorded, with no centralized digital archive accessible to stakeholders.
- Funding Shortfalls: The Trust Fund and external grants cover only a fraction of required conservation and programming costs, leading to uneven implementation.

- Institutional Capacity: Local authorities lack dedicated heritage officers; existing staff juggle multiple portfolios, weakening enforcement of Bylaws and conservation regulations.
- Community Participation: Formal consultation processes often exclude youth, people with disabilities, and informal sector participants, reducing program relevance and social uptake.

10.12 Recommendations

- Expand Inventories: Launch comprehensive surveys of intangible and tangible heritage, prioritizing undocumented rituals, dialects, and community sites; integrate results into a public GIS database.
- Secure Sustainable Funding: Capitalize the National Arts and Culture Trust Fund through tourism levies, corporate sponsorships (with tax incentives), and heritage impact fees on new developments.
- Strengthen Institutional Capacity: Establish dedicated heritage management units within municipal administrations, with trained officers for monitoring, enforcement, and community engagement.
- Enhance Community Engagement: Implement inclusive outreach strategies mobile heritage caravans, school heritage ambassadors, and disability-friendly events to democratize cultural participation.
- Strategic partnership network: Establish a formal collaborative relationship between Ezulwini Municipality and the Eswatini National Museum, which operates under the Eswatini National Trust Commission (ENTC) to document some of Ezulwini Heritage sites.
- Integrate Heritage in Tourism Planning: Develop heritage tourism circuits linking sites like Mantenga Cultural Village, Iron Bridge, and Sheba's Breast Mountain, with interpretive signage and eco-adventure offerings.
- Foster Creative Industries: Offer artist studio grants, micro-loans for artisans, and mandatory local content quotas (70% for crafts, 90% for music/film) in media broadcasts to stimulate market-focused cultural production.

10.13 Conclusion

Cultural heritage in Ezulwini is at a crossroads, policies and programmes signal progress, yet pervasive pressures from urbanization, globalization, and environmental change have stalled meaningful advances. Current efforts, including a new Arts and Culture Policy and UNESCO collaborations, indicate a foundation for improvement. However, without closing gaps in documentation, funding, capacity, and participation, the sector will remain stagnant. Through sustained investment in institutional strengthening, community-driven initiatives, and integrated tourism planning, Ezulwini can reverse this stagnation, ensuring its rich cultural and heritage legacy thrives for future generations.

11. Conclusion and Recommendations

11.1 Conclusion

Ezulwini Municipality has demonstrated significant progress in environmental management, urban planning, and sustainability over recent years. The Municipality's achievements include improved waste diversion rates, expanded renewable energy infrastructure, and increased community engagement in environmental programs. Strategic investments in infrastructure, proactive policy alignment with national and international frameworks, and innovative pilot projects, such as the Waste Separation at Source initiative, have positioned Ezulwini as a regional leader in sustainable urban management. However, persistent challenges remain, including regulatory delays, inadequate laboratory and hazardous waste management capacity, water quality non-compliance, invasive species expansion, and limited public land for green space development. These gaps, if left unaddressed, threaten to undermine the Municipality's gains and its ability to meet long-term sustainability objectives.

To solidify and accelerate progress, Ezulwini must prioritize the expedited gazetting of critical Bylaws, invest in laboratory and waste management infrastructure, and implement inclusive planning that targets vulnerable groups. Strengthening regional collaboration, enhancing data-driven decision-making, and scaling up community-based biodiversity and conservation programs are also essential. By addressing these gaps through a phased implementation of strategic recommendations, Ezulwini can build resilience, enhance public health, and ensure the sustainable use of its natural and urban resources serving as a model for other fast-growing municipalities in Eswatini and beyond.

11.2 Implementation Matrix for Key Recommendations

Environmental Governance and Sustainability

Recommendation	Timeline	Implementing Body/Partners	Estimated Cost (E)
Expedite Bylaws Approvals	Short-term (0–1 yr)	Ezulwini Municipality with Ministry of Housing and Urban Development	150,000
Pilot Hazardous Waste Collection	Short-term (0–2 yrs)	Ezulwini Municipality with EEA	600,000
Vulnerability Mapping	Short-term (0–2 yrs)	Ezulwini Municipality	300,000
Climate Integration in Urban Planning	Medium-term (2–5 yrs)	Ezulwini Municipality, Town Planning Dept	1,000,000
Regional Waste Consortium	Short-term (0–2 yrs)	Ezulwini Municipality with regional stakeholders	750,000
IoT-Enabled Monitoring	Medium-term (2–5 yrs)	Ezulwini Municipality with technology partners	1,200,000

Waste Management

Recommendation	Timeline	Responsible Parties	Estimated Cost (E)
Expand Staffing & Skills	Short-term (0–2 yr)	Ezulwini Municipality	400,000
Accelerate Bylaws Promulgation	Short-term (0–1 yr)	Ezulwini Municipality with parent Ministry	150,000
Establish Hazardous Waste System	Short-term (0–2 yr)	Ezulwini Municipality with EEA	600,000
Acquire Land for Waste Disposal Site and MRF	Medium-term (2–5 yr)	Ezulwini Municipality	12,000,000
Enhance Peri-urban Waste Inclusion	Short-term (0–2 yr)	Ezulwini Municipality with regional partners	500,000
Strengthen Data & Monitoring	Short-term (0–2 yr)	Ezulwini Municipality	300,000

Biodiversity Management

Intervention	Timeframe	Responsible Actors	Estimated Cost
Conduct Comprehensive Biodiversity Mapping	Short-term (0–2 years)	Ezulwini Municipality with ENTC	E500,000
Conduct Strategic Environmental Assessment	Short-term (0–2 years)	Ezulwini Municipality, Town Planning	E500,000
Habitat Corridor Restoration	Medium-term (2–5 years)	Ezulwini Municipality with ENTC	E400,000
Integrated Invasive Species Management	Medium-term (2–5 years)	Ezulwini Municipality with Ministry of Agriculture	E900,000/year
Scale Utilization Programs	Short-term (0–2 years)	Ezulwini Municipality with community cooperatives	E400,000
Establish Dedicated Conservation Fund	Long-term (5+ years)	Ezulwini Municipality	5% of tourism revenue
Implement Digital Monitoring Systems	Medium-term (2–5 years)	Ezulwini Municipality	E500,000

Freshwater Management

Recommendation	Timeframe	Responsible Parties	Estimated Cost (E)
Conduct Wetland Inventory and Action Plan	Short-term (0-2 years)	Ezulwini Municipality with ENTC	400,000
Expand Laboratory Capacity	Medium-term (2-5 years)	Ezulwini Municipality	4,500,000
Accelerate Bylaws Gazetting	Short-term (0-1 year)	Ezulwini Municipality	150,000
Enhance Catchment Management	Medium-term (2-5 years)	Ezulwini Municipality with upstream communities	600,000
Strengthen Community Engagement	Short-term (0-2 years)	Ezulwini Municipality	200,000

Land Use Management

Recommendation	Timeline	Responsible Party	Estimated Cost
Expand Public Land Holdings	Medium-term (2-5 years)	Ezulwini Municipality	E5,000,000
Improve Data Collection	Short-term (0-2 years)	Ezulwini Municipality	E250,000
Activate and Expand Green Spaces	Medium-term (2-5 years)	Ezulwini Municipality	E1,500,000
Formalize Green City Assessment	Short-term (0-2 years)	Ezulwini Municipality	E200,000
Upgrade Mobility and Infrastructure	Medium-term (2-5 years)	Ezulwini Municipality with national agencies	E8,000,000

Energy Management

Recommendation	Timeline	Responsible Entity	Estimated Cost (E)
Accelerate Infrastructure Upgrades	Short-term (0–2 yrs)	EEC with Ezulwini Municipality support	E15,000,000
Expedite Regulatory Development	Short-term (0–2 yrs)	EEC with Ministry of Natural Resources	E500,000
Invest in Storage Solutions	Medium-term (2–5 yrs)	Ezulwini Municipality	E2,000,000
Expand Smart Infrastructure	Medium-term (2–5 yrs)	EEC with Ezulwini Municipality	E3,000,000
Enhance Data Systems	Short-term (0–2 yrs)	Ezulwini Municipality with EEC	E300,000
Strengthen Monitoring	Short-term (0–2 yrs)	Ezulwini Municipality	E200,000
Mainstream Inclusivity	Short-term (0–2 yrs)	Ezulwini Municipality	E150,000

Air Quality and Climate Change

Initiative	Timeframe	Responsible Entity	Estimated Cost (E)
Air Quality Monitoring Network	Medium-term (2–5 yrs)	Ezulwini Municipality	1,500,000
Renewable Energy Scaling	Medium-term (2–5 yrs)	Ezulwini Municipality	3,000,000
Policy Enforcement	Short-term (0–1 yr)	Ezulwini Municipality	200,000

Public Health and Safety

Recommendation	Timeline	Responsible Party	Estimated Cost
Conduct Annual Health Surveys	Short-term (0–2 yrs)	Ezulwini Municipality with Ministry of Health	E300,000/year
Develop Environmental-Health Dashboard	Short-term (0–2 yrs)	Ezulwini Municipality	E500,000

Social and Well-being

Recommendation	Timeline	Responsible Entity	Estimated Cost (E)
Develop Mental Health Services	Medium-term (2–5 years)	Ezulwini Municipality with Ministry of Health	E2,000,000
Invest in Recreational Infrastructure	Medium-term (2–5 years)	Ezulwini Municipality	E3,000,000
Implement Integrated Social Services Framework	Medium-term (2–5 years)	Ezulwini Municipality	E500,000
Enhance Community Engagement & Inclusion	Short-term (0–2 years)	Ezulwini Municipality	E400,000

Cultural Heritage

Recommendation	Timeframe	Responsible Entity	Estimated Cost (E)
Expand Heritage Inventories	Short-term (0–2 years)	ENTC with Ezulwini Municipality	400,000
Secure Sustainable Funding	Medium-term (2–5 years)	Ezulwini Municipality with tourism stakeholders	500,000
Enhance Community Engagement	Short-term (0–2 years)	Ezulwini Municipality with traditional leaders	300,000
Integrate Heritage in Tourism Planning	Medium-term (2–5 years)	Ezulwini Municipality with tourism authorities	500,000
Foster Creative Industries	Medium-term (2–5 years)	Ezulwini Municipality with private sector	500,000

This approach ensures that urgent regulatory, capacity, and infrastructure gaps are addressed in the short term, while medium- and long-term actions focus on institutionalizing best practices, scaling up successful pilots, and embedding sustainability into all facets of Ezulwini's urban and environmental management.

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Appendix 1: Applicable Regulatory Framework

National Regulatory Framework

Legal Requirement	Responsible Ministry	Relevance
Eswatini Constitution Act of 2005	MoJ	This is the supreme law in Eswatini. Section 210 (2) provides that the state shall protect and make rational use of its land, mineral, water resources as well as its fauna and flora, and shall take appropriate measures to conserve and improve the environment for the present and future generations. The constitution is binding on all Eswatini citizens including Ezulwini context as it is the supreme law of the country
Environmental Management Act of 2002	MoTEA	Promote and provide enhancement, protection and conservation of the environment and sustainable management of the natural resources in the Ezulwini context
The Eswatini Environmental Authority Act of 1992	MoTEA	Ensure integration of environmental concerns in development and coordinate activities of all bodies concerned with environmental matters. The act has several regulations for waste management, pollution standards and environmental auditing, assessment and review guidelines.
Environmental Assessment Regulations of 2022	MoTEA	Ensures proper environmental assessments and management in new and existing developments.
Biosafety Act of 2012	MoTEA	An Act to provide for the safe handling, transfer and use of genetically modified organisms and other matters
Waste Regulations of 2000	MoTEA	Ensures proper management of solid waste and liquid waste generated from site.
The Litter Regulations of 2011	MoTEA	Provides for the control of indiscriminate littering through prohibition of littering practices which include throwing, discarding, leaving litter upon any public place, river, or any body of water in Eswatini and includes the designating of Litter Wardens.
Water Pollution Control Regulations, 2010	MoTEA	These regulations control discharges made into water bodies. They outline responsibilities for operators, water authorities and the Eswatini Environment Authority in water pollution control. They provide water quality objectives as well as effluent standards.
Air Pollution Control Regulations, 2010	MoTEA	These regulations are aimed at controlling emissions into the atmosphere. They outline responsibilities for operators, the meteorology department and the Eswatini Environment Authority in air pollution control.
Water Services Act 1992	MNRE	This Act established the Eswatini Water Services Corporation as the sole provider of water services in the urban areas (water supply, and sewage treatment and disposal) and to control the abstraction of raw water from boreholes in those areas for which it is responsible.
Water Act 2003	MNRE	Ensures proper conservation and sustainable use of water. The use of water for irrigation must be done according to statutes and the monitoring of water quality must be done.
Natural Resources Act of 1951	MNRE	Ensures the protection, preservation and sustainable use of natural resources. Measures to protect and sustainably use water, biodiversity and land must be in place at the project site.

Natural Resources (Public Stream Banks) Regulations of 1951	MNRE	The regulations are designed to protect public stream banks outside of designated Swazi areas. The regulations prohibit any person from cultivating, planting crops, or injuring or destroying natural vegetation within 100 feet of either bank or the verge of a public stream, unless they have obtained permission from the Natural Resources Board.
The Game Act of 1953 (And As the Game (Amendment) Act 1991	PM Office	Ensures the protection of game and other wildlife listed in the Red Data and Royal Game lists in The Kingdom of Eswatini. Threatened and vulnerable game must be protected, and no poaching should be allowed.
The Flora Protection Act of 2001	MoTEA	Ensures protection of indigenous flora and related concerns. Important and vulnerable flora must be protected in the project site and beyond.
The Wild Birds Protection Act of 1914	MoTEA	Provides for the protection and illegal sale of wild birds. No poaching of birds and other fauna must be done
The Forest Preservation Act of 1910	MoA	Ensures the preservation of trees and forests growing on government and Swazi Nation Land. Measures to preserve trees and forests must be done in the project.
Eswatini National Trust Commission 1972	MoTEA	It established the Eswatini National Trust Commission (ENTC) is a body corporate established by the ENTC Act of 1972. The ENTC's key objectives are both to preserve the cultural heritage and to conserve the natural heritage of the Kingdom of Eswatini. These will need to be preserved if found on site
The Public Health Act of 1969	MoH	Ensures prevention of communicable diseases and nuisances due to anthropogenic impacts. Measures to ensure prevention of incidences of public nuisances and communicable diseases should occur in the Ezulwini context
The Eswatini Administration Order of 1998	PM Office	Ensures proper administration of activities and people under the Eswatini Nation Land.
The National Trust Commission Act of 1972	MoTEA	Ensures proper operation of cultural institutions and proclamation of national parks, monuments and related matters. Measures to preserve archaeological artifacts, graves and historic sites must be in place in the Ezulwini context
The National Fire and Emergency Services Order of 1975	MoPWT	Fight, extinguish and prevent the spread of fire to protect lives and property. The Fire department should be on standby for any possible fire breakouts
Occupational Safety and Health Act of 2001	MoLSS	Ensures the safety and health of workers in the working environment. Safety and health measures should be in place for the protection of workers
Building Act of 1969	MoPWT	This legislation provides for the promotion of uniformity in the law, and building standards relating to the erection of buildings, water supply and connection, drainage and sewer etc. in the areas of jurisdiction of local authorities. All structures on site must comply with this legislation
The Children's Protection and Welfare Act 6, 2012	DPM Office	This Act prohibits employment of children and sets 15 years as the national minimum age of employment of children. The Act also safeguards children from performing hazardous duties while in employment. The contractors on site should ensure that children under 15 years are not employed in the project.

The Police Service Act of 2019	MoJ	The Act provides policing and security services in and throughout the kingdom of Eswatini. Among other things, according to the Police Service Act 2018: Section 9(1), the Police are to protect life and property as well as render assistance to members of the public where possible or appropriate including mediation and counselling in domestic violence and other matters. All security matters are the prerogative of the Police.
Sexual Offences and Domestic Violence (SODV) Act, 2018	DPM Office	This Act seeks to make provision concerning sexual offences and domestic violence, prevention and the protection of all persons from harm from other sexual acts and acts of domestic violence and to provide for matters incidental thereto. It defines sexual offences (Rape, incest, Sexual assault, sexual harassment, stalking, amongst others) and prohibits commercial sexual activities. it also outlines special offences against vulnerable groups (children, people living with disabilities. The Act also outlines procedures for reporting and investigation of offences under the Act. Workers on site may be exposed to abusive environments on site or off site. The act is relevant to all people in the country. Cases of sexual exploitation and abuse as well as domestic violence should be managed in accordance with this act.
The Electricity Act of 2007	MNRE	Act to reform and consolidate the law regulating the generation, transmission, distribution and supply of electricity and to provide for matters incidental thereto
30 Energy Regulatory Act, 2007	MNRE	This is an Act that establishes the Energy Regulatory Authority which is responsible for issuing licenses for undertakings in the energy sector, receiving and processing applications for licenses from undertakings in the energy sector, and for modification, investigations of any complaints, and disciplinary of licenses in the energy sector.
Control of Plastic Bags Regulations, 2021	MoTEA	These regulations were formulated to control the production and the use of plastic bags. The regulations make provision for promoting re- use, recycling, and the safe handling of plastic bags which is necessary for the sustainability of the environment.

Relevant Strategies and Policies

Strategy/Policy	**Responsible Ministry**	**Relevance**
National Development Strategy	Prime Minister Office	By the year 2022, the Kingdom of Eswatini will be in the top 10% of the medium human development group of countries founded on sustainable economic development, social justice and political stability
National Biodiversity Strategy and Action Plan	MoETA	It improves status of biodiversity, mainstreams biodiversity, generates relevant information
National Environment Policy	MoETA	Provides for environmental preservation in socio-economic developments
National Water Policy	MNRE	To achieve sustainable development and management of water resources in the country through integrated planning. The integrated water supply project will involve

		the abstraction of water activities of which are addressed by the policy
Poverty Reduction Strategy	MoEPD	To the incidence of absolute poverty from 69% in 2001 to 30% in 2015 and to totally eradicate it by 2022.
National Gender Policy	MoLSS	Provides for gender equality, mainstreams gender issues and influences legislation, policies and plans to achieve gender equality
The National Housing Policy	MHUD	This Policy is responsible for setting all procedures and guidelines for housing in both peri-urban and urban setting by considering soils, services and standard for structures (grading) etc.
Land Allocation Criteria and Policy	MHUD	These criteria and procedures have been developed to facilitate the allocation of occupied and unoccupied plots fairly. The criteria state clearly how the allocation of plots will be done and who can apply.
Local Economic Development Strategy for Ezulwini Municipality	MCM	The Local Economic Development (LED) Strategy for Ezulwini Municipality is a collaborative and participatory approach aimed at fostering sustainable economic growth, job creation, and improved quality of life for all residents-including the poor and marginalized. The strategy encourages partnerships among the public, private, academic, and civil society sectors to find local solutions to economic challenges and stimulate commercial activity. Key priorities of the LED Strategy include attracting investment in retail, real estate, manufacturing, and business-support services; encouraging the establishment of new small businesses; assisting existing businesses to survive and expand; and raising Ezulwini's profile to investors and tourists. The strategy also emphasizes providing information, infrastructure, and business development services to support business start-up, growth, and sustainability within the town. Implementation is aligned with the Integrated Development Plan (IDP) and focuses on sustainable development, effective governance, and public-private partnerships, while also addressing issues such as business exodus, urban poverty alleviation, and the creation of a resilient local economy.
The Ezulwini Town Planning Scheme 2018	MCM	Aimed at ensuring a co-ordinated and harmonious development of the urban area, including where necessary the identification of new growth areas, new spatial development opportunities, reconstruction and redevelopment of any part of the town.