THE INTEGRATION OF SUSTAINABILITY IN MUNICIPALITIES IN SOUTH AFRICA:

AN EVALUATION OF AN EASTERN CAPE DISTRICT MUNICIPALITY'S WATER SUPPLY DISTRIBUTION SYSTEMS

Submitted in (partial) fulfilment of the requirements for the degree of

MASTER OF BUSINESS ADMINISTRATION (*MBA*)

(FACULTY OF COMMERCE)

at the

RHODES UNIVERSITY

By

ZUKANI MAXWELE

Student Number: **22M6756**

Supervised by:

Ms. Leticia Greyling

Submission date:

25 June 2024

DECLARATION

I, **Zukani Maxwele**, hereby declare that this thesis has not been submitted for a degree in any other university and that it is my original work; it does not, in its entirety or part, exist as someone else's work and was not previously submitted to any institution. All sources utilised have been properly presented and acknowledged with complete integrity.

Signature

25 June 2024

Date

ABSTRACT

The Constitution of the Republic of South Africa mandates municipalities to provide sustainable services to communities, particularly those responsible for water and sanitation. Despite this obligation, many communities in the Oliver Reginald Tambo District Municipality (ORTDM) face prolonged water interruptions due to challenges with infrastructure.

This study has assessed the ORTDM's efforts to integrate sustainability principles into its water supply distribution systems development programmes. Essentially, it aimed to evaluate whether and how ORTDM integrates social, environmental, economic, engineering, and project management sustainability principles into its developmental initiatives. Grounded in the backdrop of global sustainable development imperatives, particularly the Triple Bottom Line (TBL) concept, the research explored challenges and considerations within local government in pursuit of sustainability in water infrastructure development.

Utilising a qualitative research approach within a post-positivism paradigm, the study employed semi-structured interviews and document analysis as primary data collection methods, emphasising triangulation for research validity and ethical considerations throughout the study. Although the initially planned sample size was 12 participants, the study successfully interviewed seven municipal officials from ORTDM's water and sanitation services delivery department, achieving a participation rate of 58%, which aligns with qualitative research standards.

Findings from document analysis and interviews were categorised based on identified sustainability principles, highlighting strategies adopted and challenges encountered by ORTDM, including opportunities available for ORTDM.

The study reveals that while ORTDM has made efforts to integrate sustainability principles, numerous challenges, including financial and natural resource constraints, organisational capacity limitations, inadequate infrastructure planning and maintenance, and socio-economic challenges, have hindered desired outcomes. Additionally, issues like vandalism, theft, biodiversity loss, and fragmented water conservation strategies exacerbate sustainability integration challenges.

To address these barriers, the study recommends prioritising management approaches to enhance sustainability integration in ORTDM's water services. Drawing on resilience theory, the study further proposes integrating resilience principles into planning, design, and management processes to improve organisational and system resilience, thus ensuring reliable and sustainable water services.

The study emphasises the importance of interdisciplinary collaboration and innovative solutions in achieving resilient, equitable, economical, and environmentally responsible water supply distribution systems.

DEDICATION

This study is dedicated to my late cousin brother, **Sandiso** “Tar Lux” **Mandla**; your absence in our lives is very loud, *mfowethu*; we all miss you.

ACKNOWLEDGEMENTS

I am most grateful to God Almighty for giving me the strength and wisdom to complete this research. *Enkosi Bawo, ngako konke ondenzele kona;*

I also wish to extend my sincere appreciation and gratitude to the following special individuals for their support, motivation, and guidance:

My supervisor, Ms Leticia Greyling, for her guidance, professional advice and leadership throughout my study period;

The research participants and contributors, without their cooperation and input, this study would not have been possible;

My family "***oo'Ndlovu' zidlekhaya ngenxa yoswelu malusi***";

My sons and nephew, Kwande "Big K" - Cwenga "C" - & Minnie, for being my pillars of strength;

Last but not least, I thank my Rhodes University community and friends, with special thanks to Vusi Mthombeni, Beauty Gungu, Kwanele Mlomzale, and Siya Mthembu.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF ACRONYMS

DWS	-	Department of Water and Sanitation
EC	-	Eastern Cape Province
EIA	-	Environmental Impact Assessment
IDP	-	Integrated Development Plan
NEMA	-	National Environmental Management Act (Act 107 of 1998)
NGOs	-	Non-Governmental Organisation(s)
NRW	-	Non-Revenue Water
ORTDM	-	Oliver Reginald Tambo District Municipality
RSA	-	Republic of South Africa
SDGs	-	Sustainable Development Goals
TBL	-	Triple Bottom Line
WCDM	-	Water Conservation and Demand Management
WSA	-	Water Services Authority
WSDP	-	Water Services Development Plan
WSP	-	Water Services Provider

CHAPTER 1: INTRODUCTION AND RESEARCH OVERVIEW

1.1 INTRODUCTION

This chapter lays the foundation for the study. The chapter commences by presenting the setting of the research. It proceeds to present the research problem to evaluate whether and how Oliver Reginald Tambo District Municipality (ORTDM) integrates sustainability principles (social, environmental, economic, engineering, and project management) in its water supply distribution systems development programmes. A preliminary analysis of research gaps indicates that this type of investigation has not been undertaken in the identified organisation, emphasising the significance of conducting the study in this specific context. The chapter concludes by introducing specific research objectives.

1.2 SETTING THE CONTEXT OF THE RESEARCH

The Eastern Cape Province of South Africa has thirty-nine municipalities, and the Oliver Reginald Tambo District Municipality (ORTDM) is one of the six district municipalities among the municipalities (O.R. Tambo District Municipality, 2020). Section 156 of the Constitution of the Republic of South Africa Act 108 of 1996 vests the executive authority for water services in local government, and "ORTDM is the Water Services Authority (WSA) and a Water Services Provider (WSP)" (O.R. Tambo District Municipality, 2020: 63). The role of the ORTDM is "to ensure that water resources and infrastructure are well maintained so that water services may be provided in an equitable, sustainable, and efficient manner to all communities within its jurisdiction" (Weyer, 2020: 2). In addition, the district is required to develop a Water Services Development Plan (WSDP) in compliance with legal mandates to "ensure adequate, efficient, cost-effective, accessible, and sustainable water services that promote enduring livelihoods and economic growth" (Tsibani, 2007: 336).

1.2.1 ORTDM SETTING

ORTDM is situated on the eastern side of the Eastern Cape Province, "measuring about 15 947 km2 in extent" (O.R. Tambo District Municipality, 2020: 50). It has a "population of 1,510 million people" living within the five (5) local municipalities within its jurisdiction (O.R. Tambo District Municipality, 2020: 55). The population of ORTDM is characterised by extreme poverty, with most people living below the minimum subsistence level and "dependent mainly on government social grants" (O.R. Tambo District Municipality, 2020: 58).

Figure 1: Location of O.R. Tambo District Municipality within the Eastern Cape (South Africa)

1.2.2 WATER SERVICES AUTHORITY LEADERSHIP MODEL

As a water services authority, the leadership structure implemented at ORTDM, like many district municipalities in South Africa, is divided into Political and Administrative arms. The political arm includes elected officials such as the mayor and councillors, who are responsible for setting policy and making decisions on behalf of the municipality, including budget approval, by-law endorsement, and decisions on major projects. Conversely, the administrative arm, headed by the Municipal Manager, is tasked with implementing the policies and decisions made by the political arm. This arm comprises professional staff, including the Municipal Manager, who manages the municipality's day-to-day operations.

For organisations like ORTDM responsible for water infrastructure service developments, their leadership must foster an organisational culture conducive to sustainability and resilient infrastructure projects (Boin and van Eeten, 2013). This necessitates establishing a coherent and clearly defined strategy for sustainability and resilience, outlining goals, targets, and metrics pertaining to water infrastructure. The strategy should encompass initiatives aimed at securing adequate funding, implementing sound and pragmatic policies, devising effective operation and maintenance plans, ensuring a skilled workforce, minimising water consumption, conserving water resources, and mitigating the environmental footprint of the organisation's activities (Muller, 2014).

1.3 KEY LEGISLATION GUIDING DEVELOPMENT IN SOUTH AFRICAN MUNICIPALITIES

In South Africa, several policies and legislation were promulgated post-1994, requiring local government as the sphere responsible for planning to integrate all the sustainability principles into their policy formulation, development planning, implementation, and decision-making (Wynberg and Sowman, 2007). Among the critical legislation promulgated are the National Environmental Management Act (Act 107 of 1998) and the Water Services Act (Act No. 108 of 1997).

Sustainable development (sustainability) is legally defined under the National Environmental Management Act (Act 107 of 1998) as "the integration of social, economic, and environmental factors into planning, implementation, and decision-making to ensure that development serves the present and future generations" (Republic of South Africa, 1998: 9). The definition of sustainable development further informs the integration of sustainability in water and sanitation services development programmes by state organs.

The Water Services Act (Act 108 of 1998) guarantees the "right of access to water supply and basic sanitation essential for securing adequate water and an environment conducive to human health and well-being" (Kotzé, 2010: 148). It also acknowledges the duty of all government levels to ensure that water supply and sanitation services are provided efficiently, fairly, and sustainably (Kotzé, 2010). The Act outlines the responsibilities of municipalities designated as Water Services Authorities (WSA), guiding them in "ensuring access to water services, planning for water services development, regulating water services provision, and delivering efficient, affordable, economical, and sustainable water supply services to all current and potential consumers within their jurisdiction growth" (Tsibani, 2007: 336).

1.4 WATER INFRASTRUCTURE DEVELOPMENT PLANNING IN SOUTH AFRICAN MUNICIPALITIES

Adopting the 2030 Agenda with the 17 Sustainable Development Goals (SDGs) has resulted in countries like South Africa adopting development policies and strategies to align their developmental activities towards sustainable development goals (Weaver, O'Keeffe, Hamer and Palmer, 2019). Among the 17 Sustainable Development Goals - SDG 6 is crucial for Water Services Authorities as it relates to the "provision of clean water and sanitation", a key responsibility of a municipality categorised as a Water Services Authority (Russo, Alfredo and Fisher, 2014). The increased awareness of the importance of sustainable development has led to many municipalities incorporating the SDGs among their key strategic goals to align their

planning policies to reflect a more sustainable approach to infrastructure development (Krantz and Gustafsson, 2021).

The shifting by municipalities to an integrated form of infrastructure development planning required the development of instruments and mechanisms to drive development (Harrison, 2001). Municipalities use an Integrated Development Plan (IDP) as a strategic planning instrument to manage and guide all municipality's planning, development, and decision-making processes (Harrison, 2001). The IDP contains a Water Services Development Plan (WSDP) that encapsulates a municipality's responsibilities and tasks in water service delivery, including driving sustainable development (Haigh, Fox and Davies-Coleman, 2010).

1.5 RESEARCH PROBLEM

The right of access to reliable and sustainable water supply is enshrined in Chapter 2 of the Constitution of the Republic of South (Republic of South Africa, 1996). Many communities around the country still do not enjoy this right due to persistent and extended water supply service interruptions facing water service authorities nationwide, including the ORTDM (Masuku and Jili, 2019).

Enhancing sustainable water supply provision is a crucial developmental requirement for rural and urban populations, playing a vital role in overall sustainable development (Zvobgo, 2020). Local government is expected to perform in key areas, including "meeting development needs, providing services, ensuring financial viability, fostering local economic development, facilitating planning, and maintaining good governance" (Republic of South Africa, 2009: 8). However, studies indicate that South African local government faces challenges in meeting these performance expectations (Nzewi, Ijeoma, Sibanda and Sambumbu, 2016: 39). Challenges such as poor organisational culture, financial irregularities, corruption, maladministration, weak leadership, skill shortages, and inadequate service delivery are prevalent in municipalities, including ORTDM (Masuku and Jili, 2019: 1).

The sustainability of water services is determined by water supply continuity, the proper functioning of equipment, and the resilience of infrastructure (Selala, Senzanje and Dhavu, 2019: 291). However, many South African communities face over fourteen days of water interruptions due to non-functional water infrastructure resulting from insufficient infrastructure operations and maintenance (Hofstetter, van Koppen, and Bolding, 2021: 253). In ORTDM, interruptions force rural communities to rely on potentially unsafe water sources from rivers and springs, posing health risks. Restoring water supply services after disruptions exposes inefficiencies in the municipality's resilience and the water supply distribution systems, emphasising the need to enhance both organisational and distribution systems

resilience. Building resilience involves developing water infrastructure capable of withstanding natural disasters, diversifying water sources, and creating contingency plans.

Sebidi and Madue (2018) found a correlation between organisational culture and service delivery. They proposed that integrating resilience and sustainability into organisations cultivates a culture that improves overall performance, including the resilience of water supply distribution systems and the sustainability of water services (Sebidi and Madue, 2018). Juan-García, Butler, Comas, Darch, Sweetapple, Thornton and Corominas (2017) link water infrastructure resilience to the organisation's ability to develop plans and strategies for managing risks and disruptions. Further, Bahadur, Ibrahim, and Tanner (2013) attribute resilient infrastructure systems to effective governance and institutional creativity, advocating for the inclusion of resilience enhancement strategies in infrastructure development plans for effective design and implementation.

The Water Services Act (Act No 108 of 1997) notes that sustainability must be considered when developing municipal water services. To achieve sustainable development, the organs of the state must integrate all the sustainability principles into their policy formulation, development planning, implementation, and decision-making (Wynberg and Sowman, 2007). Integrating sustainability into the organisation's processes, such as planning, managing, and executing infrastructure projects, is crucial for ensuring the sustainability of the projects and the infrastructure assets they produce (Goel, Ganesh and Kaur, 2019). However, many municipalities worldwide struggle to integrate sustainability considerations into their planning and execution of infrastructure development and water services delivery (Stuart, Collins, Alger and Whitelaw, 2016). The sustainability of water supply and its delivery processes is paramount, given their substantial "social, economic, and environmental implications" (Li, Xia, Wen, Wang and Lv, 2019: 3).

The concept of sustainable development now directs both public and private organisations toward environmental reform (Boström, 2012). The Triple Bottom Line (TBL) principle is critical in evaluating their performance in achieving "sustainability (social equity, environmental quality, and economic benefits)" in their initiatives (Correia, 2019: 30). This creates an opportunity to research and better understand the sustainability integration considerations and challenges for local government, which is a key focus of this study.

Against this background, this research evaluates whether and how ORTDM integrates sustainability principles (social, environmental, economic, engineering, and project management) in its water supply distribution systems development programmes. The ORTDM is no stranger to sustainability or service delivery challenges, especially regarding water infrastructure and services. ORTDM experiences challenges maintaining the long-term

sustainability of its infrastructure, given the operations and maintenance limits outlined in its integrated development plan (O.R. Tambo District Municipality, 2020: 193). The outcomes from this research will assist the municipality in improving the sustainability and resilience of its water supply distribution systems.

1.6 RESEARCH AIM AND OBJECTIVES

The main aim of the research was to evaluate the integration of sustainability principles in an effort to improve the resilience of water supply distribution systems in the ORTDM.

Specific objectives of the study included:

1. To assess the integration of sustainability principles in the municipal water supply distribution system's development programmes.
2. To investigate the challenges and opportunities associated with integrating sustainability principles into water supply distribution systems, as perceived by the municipality.
3. To propose recommendations on how ORTDM can improve the sustainability of water supply services in an effort to improve their resilience.

CHAPTER 2: LITERATURE REVIEW AND UNDERPINNING THEORY

2.1 INTRODUCTION

This chapter presents the theoretical and empirical literature on sustainable development (sustainability), integration of sustainability principles in the context of local government (municipalities), and water service delivery programmes. The chapter explains how sustainability integration in planning, implementation, and decision-making processes can improve the resilience of municipal water supply distribution systems. It concludes by presenting the resilience theory as the underpinning theory of the research.

2.2 SUSTAINABLE DEVELOPMENT AND SUSTAINABILITY CONCEPTS

Sustainable development emerged as a concept in the 1980s, with the publication of the Brundtland Report in 1987, which defined it as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (Echebarria, Barrutia, Eletxigerra, Hartmann and Apaolaza, 2018: 1289). They further assert that "sustainable development covers a holistic view of needs in ways that are renewable or viable in the long term" (Echebarria et al., 2018: 1289). Needs include providing "economic, environmental, and ecosystem services and cultural objectives, such as identity and arbitrary values" (Russo, Alfredo and Fisher, 2014: 3935).

Sustainable development is closely tied to "considerations of equity, welfare, lifestyle" and the desire for enhanced living standards in many countries (Trinder, 2008: 1421). While developments aim to improve living standards, they also have adverse effects on the environment, economy, and society (Goel, Ganesh and Kaur, 2019). Factors such as the growth in local population can drive the need for new developments, resulting in heightened utilisation of natural resources (Trinder, 2008). These consequences may not be immediately evident. Thus, assessing the extent of these impacts is essential to inform organisational development decisions.

Bakshi and Fiksel (2003: 1350) have criticised the U.N. definition of sustainable development, arguing that "it is not particularly helpful for engineering decision-making", such as in the context of municipal decisions regarding critical engineering projects. They propose an alternative definition, stating that "a sustainable product or process limits resource consumption and waste generation to an acceptable level, makes a positive contribution to satisfying human needs, and provides long-term economic value to the business enterprise" (Bakshi and Fiksel, 2003: 1350). Their definition is more relevant to engineering decision-making and aligned to an engineering product such as built infrastructure assets or project management process. Russo, Alfredo and Fisher (2014: 3932) refer to sustainable development

as “the combination of maintaining the natural environment, available resources, and local community with the advancement of economic and societal objectives”.

The normative definition of sustainability outlines a set of guiding principles directing actions and policies toward a more sustainable future. Rooted in the principle of intergenerational equity, it emphasises the current generation’s moral obligation to ensure that future generations inherit the same resources and opportunities they currently enjoy (Amaral, Martins and Dias, 2023). This definition recognises the ethical, moral, and social imperatives inherent in pursuing sustainability and provides a framework for decision-making that considers the long-term consequences of actions and policies. It arises from the realisation that existing economic, social, and environmental development trajectories are unsustainable, necessitating urgent action to address these challenges (Holden, Linnerud and Banister, 2017). Common sustainability imperatives encompass “eradicating extreme poverty, enhancing human capabilities, promoting inclusive participation, ensuring equitable distribution of the planet’s resources, mitigating climate change, and protecting biosphere integrity” (Holden, Linnerud and Banister, 2017: 216). Leigh and Lee (2019: 3) describe sustainability as “the physical and institutional practices that meet the needs of the present without compromising the ability of future generations to meet their own needs”. This definition highlights the connection between sustainability and sustainable development. This relationship advocates for continued management of infrastructure assets to ensure future benefits.

Sustainable development is a “specific approach aimed at balancing economic, social, and environmental factors” (Boström, 2012: 3). This approach guides public and private organisations in their pursuit of environmental reform (Boström, 2012). The Triple Bottom Line (TBL) concept is crucial in evaluating their performance in achieving “sustainability (social equity, environmental quality, and economic benefits)” (Correia, 2019: 30). Essentially, sustainable development aims to achieve long-term viability by employing development strategies that are sustainable from a social, economic, and environmental perspective (Baumgartner and Ebner, 2010). Thus, sustainable development serves as a framework for organisations to implement sustainability holistically, ensuring that their initiatives are balanced across all three sustainability dimensions.

2.3 SUSTAINABILITY PRINCIPLES RELEVANT TO WATER INFRASTRUCTURE

According to Morrison-Saunders and Therivel (2006: 282), “sustainability is often considered in terms of the three pillars, namely environmental, social, and economic considerations”. However, Li et al. (2019: 3) emphasise that “it is equally crucial to consider both the sustainability of project deliverables (engineering sustainability) and the sustainability of

delivery processes (project management sustainability), as both can significantly impact society and the environment". Thus, for this study, the criteria is extended to include the two additional pillars applicable to infrastructure projects as proposed by Li et al. (2019). The sustainability principles are defined and evaluated in the context of water supply distribution systems development in the following section:

2.3.1 SOCIAL SUSTAINABILITY

Social sustainability lacks a clear, universally accepted definition due to its complexity and difficulty quantifying (Dempsey, Bramley, Power and Brown, 2011; Li et al., 2019; Hale, Legum, Campbell and Carolan, 2019). As a result, scholars define the concept from various perspectives (Li et al., 2019).

According to Basiago (1999: 149), social sustainability "encompasses concepts of equity, empowerment, accessibility, participation, cultural identity, and institutional stability". Allen (2001: 155) describes it as "actions and policies aimed at improving quality of life and ensuring fair access and distribution of rights over the use and appropriation of natural and built environments". Li et al. (2019: 5) define social sustainability as "providing the public with satisfactory goods and services while enhancing the social development potential of the project area, offering local employment opportunities, and improving quality of life". Lastly, Boström (2012: 5) adds that social sustainability often "involves enhancing conditions for current and future generations and ensuring quality governance in the development process".

Social sustainability encompasses various dimensions to improve quality of life, ensure equitable access to resources, and foster long-term community well-being.

2.3.2 ENVIRONMENTAL SUSTAINABILITY

Environmental sustainability involves "the rational management of natural resources and the control of waste produced by society, requiring an integrated view of local, regional, national, and international development and environmental trends" (Allen, 2001: 155). Morelli (2011: 6) further defines environmental sustainability as "meeting the resource and service needs of current and future generations without compromising the health of the ecosystems that provide them".

However, the ongoing need to improve human well-being through activities like "construction continues to contribute to environmental degradation, and this impact is still growing" (Nathaniel, Nwulu and Bekun, 2021: 6212). This persistent issue is linked to the relationship between natural resource use and economic growth. Integrating sustainability principles into

infrastructure planning, design, and construction can help promote resource efficiency and conservation practices, addressing this challenge (Nathaniel, Nwulu and Bekun, 2021).

2.3.3 ECONOMIC SUSTAINABILITY

Allen (2001: 155) defines economic sustainability as "development that is financially feasible and supports social and environmental sustainability without causing irreversible damage to the natural resources it relies on". Furthermore, this is achieved by ensuring that development impacts are contained within the area where development occurs and that consumption of natural resources does not negatively affect regions not benefiting from developments (Allen, 2001). Basiago (1999: 150) complements this by stating that "economic sustainability implies a production system that meets current consumption levels without compromising future needs". Both definitions emphasise the balance between current development and future resource availability, highlighting the importance of localising development impacts and preserving resources for the future.

2.3.4 ENGINEERING SUSTAINABILITY

Li et al. (2019: 5) define engineering sustainability as "the application of engineering practices and principles to design, develop, and manage technologies, systems, and processes in ways that minimise negative impacts on the economy, society, and environment for both current and future generations". Achieving sustainable engineering involves "making decisions that consider the sustainable development of projects, including their durability, operational and maintenance requirements, and the sustainability of the technology itself" (Li et al., 2019: 5). Ceschin and Gaziulusoy (2016: 136) further this concept by emphasising the need for municipalities and engineers to "adopt a holistic perspective when developing socio-technical systems", such as water supply distribution systems. They must consider not only the technical performance but also the social and environmental effects throughout the system's lifecycle (Ceschin and Gaziulusoy, 2016). Both perspectives highlight the importance of understanding the interconnectedness of various elements and their impacts on different stakeholders to achieve true engineering sustainability.

2.3.5 PROJECT MANAGEMENT SUSTAINABILITY

According to Li et al. (2019: 5), project management sustainability is about "ensuring that projects are delivered in a manner that is profitable, fair, transparent, safe, ethical, and environmentally friendly". This approach aims to produce "deliverables that are socially and environmentally acceptable throughout their entire life cycle" (Li et al., 2019: 5). According to Silvius and Marnewick (2022: 938), "moving towards more sustainable business practices involves changing an organisation's products, services, processes, policies, and resources".

This transition requires "integrating sustainability into the organisational strategy, project portfolio management, and project management" (Silvius and Marnewick, 2022: 939). In essence, project management sustainability encompasses the holistic integration of sustainability principles into every aspect of project delivery, ensuring long-term benefits for both society and the environment.

2.4 SUSTAINABILITY INTEGRATION CONCEPT

According to Calabrese, Costa, Levialdi and Menichini (2019: 166), sustainability integration involves "embedding sustainability considerations into all aspects of an organisation's processes, strategies and long-term vision". Further, Kiesnere and Baumgartner (2019: 1609) define sustainability integration as "ensuring that sustainability permeates every organisational unit and management level to contribute to sustainable development effectively". This means organisations must consider social and environmental factors at the strategic management level when evaluating external developments and internal strengths and weaknesses. This approach helps establish "long-term objectives, policies, and plans that align with sustainable development goals" (Kiesnere and Baumgartner, 2019: 1609). Therefore, sustainability integration should be applied throughout the organisation, influencing decision-making processes at every level to ensure a comprehensive commitment to sustainability.

The integration of sustainability in municipalities has been widely discussed in the literature, highlighting the importance of local governments in promoting sustainable development at the community level (Harrison, Todes and Watson, 2008). The literature emphasises the importance of establishing effective governance structures, regulatory frameworks, and policy instruments that promote sustainable practices (Harrison, Todes and Watson, 2008). This includes integrating sustainability into infrastructure planning regulations, construction project delivery processes, procurement policies, and the entire project life cycle (Goel, Ganesh and Kaur, 2019). Sustainable development plans often involve extensive stakeholder engagement, data analysis, and the establishment of indicators to track progress. Municipalities are critical in creating governance and policy frameworks that support sustainability (Hilding-Rydevik, Håkansson and Isaksson, 2011).

Achieving some of the sustainable development goals (SDGs) by 2030, including SDG6, is dependent on municipalities integrating sustainability into their infrastructure development strategies and planning processes (Bieber, Ker, Wang, Triantafyllidis, van Dam, Kopperlaar and Shah, 2018: 585). However, while many municipalities have embraced the sustainability rhetoric in delivering essential services such as water supply services, they experience challenges and opportunities when integrating sustainability into their activities.

Municipalities must foster a culture supporting sustainability to successfully integrate sustainability principles into the development of the water supply distribution system (Kiesnere and Baumgartner, 2019). In local government, this means municipalities must align their strategic goals, policies and daily operations with sustainability principles, ensuring that every decision and action supports sustainable development. The availability of sustainable development policies and strategies allows municipalities to achieve sustainability integrations.

Embracing sustainability offers numerous opportunities for municipalities. According to Calabrese et al. (2019), integrating sustainability can strengthen relationships with the community and employees. On the other hand, socially responsible practices, such as fair labour practices and community engagement, enhance corporate image and stakeholder satisfaction (Calabrese et al., 2019). Additionally, sustainability practices can lead to resource conservation and reduced operational costs over time, providing environmental benefits (Zhong and Wu, 2015). Improved infrastructure and organisational resilience are potential outcomes (Pagano, Pluchinotta, Giordano and Fratino, 2018). Furthermore, sustainability integration can increase funding opportunities (George, Siti-Nabiha, Jalaludin and Abdalla, 2016) and enhance the sustainability of project deliverables (Goel, Ganesh and Kaur, 2019). Thus, integrating sustainability not only benefits the environment but also improves operational efficiency, financial stability, and community relations.

Challenges in achieving sustainability integration include "competing stakeholder needs, scarcity or lack of methods to integrate sustainability in the organisation's decision-making processes, resource and capability constraints, and poor planning" (Calabrese et al., 2019: 166). Integrating sustainability practices in municipal operations is challenging as it requires significant financial investments that can strain "municipal budgets and technical expertise, particularly in smaller municipalities" (Pasquini, Ziervogel, Cowling and Shearing, 2015: 64). Other challenges include climate change and population growth as they affect water sources and distribution system's functionality, thus disrupting sustainable water supply provision by municipalities (Bieber et al., 2018). Repairing and upgrading these systems to meet sustainability standards can be costly and disruptive.

While competing stakeholder needs, resource constraints, and environmental factors like climate change pose difficulties, organisations that prioritise sustainability and integrate it into their culture, practices, and strategies can reap numerous benefits, including stakeholder satisfaction, policy guidance, and long-term resilience, associated with sustainability integration (Calabrese et al., 2019). Further, in the context of local government, municipalities can leverage these opportunities to create more sustainable and resilient water supply systems

for their communities by considering all pillars of sustainability in decision-making and project planning (Baumgartner and Ebner, 2010).

2.4.1 SOCIAL SUSTAINABILITY INTEGRATION

Integrating social sustainability involves embedding social considerations and goals into various decision-making, planning, and implementation processes (Kiesnere and Baumgartner, 2019: 1609). It seeks to achieve social dimensions, such as equity, equal rights, access to social infrastructure and essential services, stakeholder participation, and people's well-being, which are integrated into policy frameworks, programs, projects, and practices (Boström, 2012).

Social sustainability can be achieved by ensuring that social considerations are explicitly addressed in policy documents and guidelines across sectors such as water and sanitation, transportation, and environmental management (Allen, 2001). In municipalities, the processes that lead to the development of an Integrated Development Plan are used as mechanisms to involve communities in planning and decision-making (Ababio, 2004: 284).

According to Freeman (2004: 229), a stakeholder is "any individual, group, or entity that can affect or is affected by an organisation or project's actions, decisions, or outcomes". The stakeholder theory recognises that organisations are responsible for considering the interests of all stakeholders, not just shareholders or owners when making decisions and pursuing their objectives. The stakeholder theory emphasises the importance of managing relationships, engaging stakeholders to understand their needs, expectations, and concerns, and incorporating their perspectives into decision-making processes (Parmar, Freeman, Harrison, Wicks, Purnell and de Colle, 2010).

In infrastructure project development, "active stakeholder participation has the potential to enhance the quality of infrastructure planning" and increase project acceptance and social capital (Roovers and van Buuren, 2016: 3). These stakeholders may include community members, organisations, government agencies, non-profit groups, businesses, and other relevant entities. Furthermore, stakeholder participation is defined as "the active involvement and engagement of people, groups, or organisations that have a stake in or are impacted by a particular project, choice, or initiative" (Nangoli, Namayingo, Kabagambe, Namono, Jaaza and Ngoma, 2016: 183). Promoting stakeholder participation is crucial for informed decision-making, transparency, accountability, and achieving positive outcomes that align with the needs and aspirations of the stakeholders involved (Ababio, 2004).

Improved quality of life in communities refers to "enhancing the well-being and overall standard of living for the people living within a particular community" or municipal jurisdiction (Li et al., 2019: 5). It encompasses various aspects of individuals' lives, including their physical,

social, economic, environmental, and psychological well-being (Boström, 2012). When the quality of life in a community improves, it means that the community members have access to essential services and resources, enjoy a safe and healthy environment, experience social inclusion and cohesion, have access to economic opportunities, and can meet their basic needs (Boström, 2012: 6). It goes beyond mere material wealth and includes factors such as social relationships, personal fulfilment, access to education and healthcare, cultural and recreational opportunities, and a sense of security and belonging (Boström, 2012). Well-maintained infrastructure, including transportation systems, public spaces, recreational facilities, and cultural amenities, enhances community livelihood and improves the quality of life (Li et al., 2019).

Promoting equitable distribution of water infrastructure involves ensuring that all individuals and communities have fair and equal access to reliable and safe water supply systems (Li et al., 2019). This requires a combination of targeted investments, community engagement, policy advocacy, and collaboration among stakeholders (Ababio, 2004: 285). By prioritising equitable access, marginalised communities can benefit from improved water infrastructure, enhancing the quality of life and sustainable development (Boström, 2012).

Promoting the realisation of the right to fair access to resources involves advocating for equitable distribution and ensuring that individuals and communities have equal opportunities to access essential resources (Dempsey et al., 2011). This can be achieved by encouraging participatory decision-making processes involving diverse resource allocation (Ababio, 2004). Addressing underlying structural inequalities that contribute to unfair resource access and promoting the inclusion of marginalised groups ensures their voices are heard and their specific needs are considered in decision-making processes (Hill and Bowen, 1997).

2.4.2 ENVIRONMENTAL SUSTAINABILITY INTEGRATION

Integrating environmental sustainability involves incorporating environmental considerations and goals into decision-making processes, policies, and practices across various sectors, including governments and the public sector (Ruwanza and Shackleton, 2016). It ensures that environmental protection, conservation, and sustainability are integrated into all organisation and human activities (Kiesnere and Baumgartner, 2019).

Decision makers in their development planning and execution process must utilise tools such as Environmental Impact Assessments (EIA) to identify, manage and monitor the use of natural resources and help reduce the negative impacts of developments on the environment (Morgan, 2012). Using the EIA processes to integrate environmental concerns and sustainability issues in infrastructure development programmes promotes better

planning and design outcomes (Saidi, 2010). EIA assists in bringing to the fore the potential environmental impacts that a proposed development poses to the environment, allowing decision-makers to consider alternatives (Ortolano and Shepherd, 1995: 4). According to Hill and Bowen (1997: 233), attaining sustainable construction necessitates applying EIA principles, procedures, and methods during project planning and design stages. Developing infrastructure to provide public services like water in an environmentally sustainable manner requires expert human resources and capable leadership to institutionalise environmental management strategies and policies (Savira and Tasrin, 2018).

The integration of the EIA process in project planning and decision-making processes has been criticised and labelled as a "technical process that does not accommodate politics" (Ortolano and Shepherd, 1995: 4). Thus, in some developments, especially private developments, consideration is given to prioritising the economic benefits of projects and developments at the expense of the environment. The dilemma faced by developers and governments in the 21st century is the question of "how do they continue to provide services to meet the needs of the citizens without compromising the natural environment?". This study aims to contribute to this important aspect.

2.4.3 ECONOMIC SUSTAINABILITY INTEGRATION

Integration of economic sustainability involves incorporating economic considerations and goals into decision-making processes, policies, and practices to ensure that economic activities are conducted to promote long-term viability, efficiency, and prosperity while considering social and environmental dimensions (Hill and Bowen, 1997). Sustainable economic development fosters economic growth that is sustainable, inclusive, and resilient. Promotes diverse and competitive sectors that generate employment, increase productivity, and contribute to long-term financial stability (Hill and Bowen, 1997). Sustainable economic development encourages innovation, entrepreneurship, and investment in sustainable technologies and practices (Smedby and Quitzau, 2016).

Integration of the economic sustainability dimension in project planning processes aims to ensure that the infrastructure delivery processes not only yield immediate benefits but also provide sustained long-term benefits and contribute positively to the economic growth of the community they serve (Aarseth, Ahola, Aaltonen, Okland and Anderson, 2017). They should create job opportunities, enhance the quality of life for residents, and achieve public satisfaction in the region (Li et al., 2019: 9).

In municipal infrastructure planning, the decision-makers, planners, and designers involved in the projects must take a long-term perspective. This means effectively integrating the construction stage with the operation and maintenance stage of the infrastructure (Zhong and Wu, 2015). By doing so, the project's life cycle cost can be reduced, and the infrastructure can be maintained efficiently over its entire lifespan, with minimal impact on the municipality's financial position and the environment (Labuschagne and Brent, 2005: 162). The focus should not solely be on short-term construction benefits but rather on ensuring the long-term effectiveness and cost-effectiveness of the operation and maintenance of the developments (Zhong and Wu, 2015).

To ensure economic sustainability, local governments must also be able to fund, deliver, manage, and operate infrastructure projects over time (Zhong and Wu, 2015: 749). This stability in funding and financial support is vital to maintaining and improving the infrastructure in the long run. Economic sustainability is achieved when development can preserve its productive capacity for an infinite future (Kuhlman and Farrington, 2010: 3439).

2.4.4 ENGINEERING SUSTAINABILITY INTEGRATION

Integrating engineering sustainability involves incorporating sustainable principles, practices, and considerations into the engineering project planning, design, and construction processes. Thus, to achieve engineering sustainability, project plans and designs should incorporate resource consumption reduction, life cycle costing, and focus on quality (Aarseth et al., 2017: 1075). Life cycle costing considers "the cost of an infrastructure asset, or its parts throughout the asset life cycle while fulfilling the performance requirements" (Zhong and Wu, 2015: 749). The requirements may include service provision to beneficiaries to enhance social prosperity and improve economic performance (Aarseth et al., 2017). The engineering sustainability integration process ensures that engineering activities contribute to long-term environmental, social, and economic sustainability. One way to ensure sustainability is "conducting life cycle assessments to evaluate engineering project's social, environmental, and economic impacts throughout their life cycle, from raw material extraction to disposal" (Zhong and Wu, 2015: 749).

To ensure service sustainability, the project's physical infrastructure should be designed and constructed with durable and high-quality materials (Schlangen and Sangadji, 2013: 41). This includes selecting durable infrastructure components and incorporating resilience measures into engineering design practices to enhance the ability of engineering infrastructure to withstand and adapt to climate and other related risks that might lead to service disruptions (Schlangen and Sangadji, 2013). Sustainable construction techniques and quality assurance

measures are also essential to ensure the infrastructure's reliability, functionality, and durability (Hill and Bowen, 1997).

According to Zhong and Wu (2015: 749), constructability refers to "how much the design of infrastructure assets simplifies the construction process and how the chosen construction techniques and processes influence the performance of those assets". Furthermore, achieving engineering sustainability requires selecting and using environmentally friendly technologies that satisfy the principle of constructability (Zhong and Wu, 2015).

Water supply distribution systems projects include adopting intelligent technologies for monitoring water flow, pressure, and leak detection, which can optimise system performance and reduce water losses (Pathirana, Heijer and Sayers, 2021). This section's discussion clearly shows that engineering and environmental sustainability are integrated, allowing for various improvement opportunities.

2.4.5 PROJECT MANAGEMENT SUSTAINABILITY INTEGRATION

Integrating project management sustainability involves incorporating sustainable principles, practices, and considerations into the project management processes. Project Management Sustainability to be achieved requires consideration to be given to the delivery process of the asset being created. The delivery process must conform to project management processes considering the project life cycle (Project Management Institute, 2008). The project life cycle includes Planning, Design, Construction, and Close-out. In all these project phases, monitoring of the execution of the work is present, ensuring the quality of a delivered product and creating value for beneficiaries (Brioso, 2015). According to Sullivan, project management practitioners in the construction industry have mainly focused on the "six project constraints (Scope, Cost, Time, Quality, resources, and risks) while ignoring the project sustainability dimension" (Silvius and Schipper, 2014: 75). This has led to unsustainable project delivery processes and unsustainable project deliverables. Organisations have realised the need to integrate sustainability principles in project delivery processes to improve the sustainability of assets (Goel, Ganesh and Kaur, 2019). Thus, to reverse the original approach's consequences, "project delivery must be coordinated and done in a profitable, fair, transparent, safe, ethical, and environmentally friendly manner" (Silvius and Schipper, 2014: 79). Adopting a sustainable approach to development will lead to delivered assets being socially, environmentally, and economically acceptable, with little to no negative impact on the pillars of sustainability.

Projects are seen as drivers of societal change (Silvius, 2017). Therefore, making project management practices sustainable is crucial in the construction industry, considering "the significant harmful impact construction activities have on environmental, economic, and social

sustainability" (Fathalizadeh, Hosseini, Silvius, Rahimian, Martek and Edwards, 2021: 1). Silvius (2017: 1485) proposes that organisations should include "stakeholder management, value management, and environmental management strategies to integrate sustainability in projects to achieve sustainable projects". Encouraging and facilitating active stakeholder participation in the early phases of project planning can ensure enhanced project quality and success (Fageha and Aibinu, 2013).

In their study, Fathalizadeh et al. (2021: 11) identified "lack of sustainability knowledge; sub-par investment in innovation; ambivalent societal concern; and absent motivation for transition within construction firms" as some of the barriers to sustainability integration in construction project management. Silvius (2017) pointed to the cost premium associated with using sustainable approaches, which leads to increased project financial feasibility, as a deterrent to adopting sustainable construction projects.

2.5 RESILIENCE BUILDING

The local government's ability to provide sustainable water supply service to communities relies on building resilient infrastructure. To achieve this, local government organisations must incorporate resilience thinking into their strategic planning and decision-making processes (Folke, Carpenter, Walker, Scheffer, Chapin and Rockstrom, 2010). Resilience thinking involves intentionally developing socio-technical systems and organisational capabilities to adapt to, respond to, and mitigate disruptions (Folke et al., 2010).

Organisational resilience, as defined by Burnard and Bhamra (2011: 5587), is an "emergent property of organisational systems, characterised by the inherent and adaptive qualities that enable an organisation to adapt during turbulent periods". Bhamra, Dani and Burnard (2011: 5376) further describe organisational resilience as "the ability to respond to disturbances or discontinuities". The degree of resilience depends on resource availability and organisational capabilities (Bhamra, Dani and Burnard, 2011).

Systems resilience, as defined by Ahern (2011: 342), citing Walker and Salt (2006), is "the capacity of a system to respond to change or disturbance without altering its fundamental state". In the context of water supply infrastructure, Diao (2021: 450) describes resilience as "the ability to minimise the magnitude and duration of service failures and maximise the time before failure impacts occur over the system's design life". For water supply systems, resilience means maintaining essential functions and adapting to external changes even when facing significant disturbances, thus ensuring service sustainability (Leigh and Lee, 2019). Organisations responsible for water infrastructure must develop and manage systems that embody these resilient qualities to provide a consistent and reliable water supply.

The adaptive ability of systems is influenced by the organisation's ability "to source, allocate and manage financial resources critical in ensuring the continued functioning of systems, therefore resilience" (Simpson, Simpson, Shearing and Cirolia, 2019: 258). Therefore, managers in organisations such as municipalities should be aware of the organisational capabilities, strengths, weaknesses, limitations, and resource constraints and be able to apply the knowledge gained when making infrastructure development decisions (Zhu, Manandhar, Truong, Ganapati, Pradhananga, Davidson and Mostafavi, 2017).

External factors such as climate change, world and local economy, culture, laws, and legislation impact how organisations conduct business operations and build the resilience of their services (Juan-García et al., 2017). Therefore, water utility organisations, decision-makers, and managers must be aware of their environment, particularly the disturbances the system is likely to experience, including their severity and frequency (Ahern, 2011).

The knowledge about systems resilience capabilities and the awareness of risks to systems would contribute to developing robust management strategies and response approaches, including timely implementation to avert system failures (Amarasinghe, Liu, Egadawatta, Barnes, McGree and Goonetilleke, 2017). Moreover, Ahern (2011: 342) suggests that building resilience capacity "requires developing an adaptable social infrastructure to assure meaningful participation and achieve equity in the face of socioeconomic change and disruption, as well as meaningful involvement of stakeholders in planning and policy decisions". Therefore, in building water infrastructure resilience, stakeholders should develop strategies and policies that promote appropriate design standards, ensure high-quality construction, operation, and maintenance, and consider climate impacts (Juan-García et al., 2017).

It is worth noting that infrastructure resilience is a multidimensional concept that encompasses not only the physical aspects of infrastructure but also the social, organisational, human, and process elements that support its functionality (Zhu et al., 2017). Recognising and addressing these broader dimensions is essential for building infrastructure systems that can withstand and recover from various disruptions, whether natural disasters, technological failures, or other unexpected events.

2.6 RESILIENCE THEORY

The underpinning theory used is resilience theory. Resilience theory is a concept that focuses on an organisation's and organisation system's ability to withstand and adapt to disturbances or shocks while maintaining its core functions and services (Holling, 1973). Resilience is defined as "the ability of a system, organisation, community, and region to anticipate, absorb, resist, respond to, adapt to, and recover from a disturbance" (Fallon, Jones and Keskinen, 2022:

3). When applied to an organisation's water supply distribution systems, resilience theory seeks "to ensure that these systems can withstand disruptions, recover quickly", and continue providing reliable water supply services to customers (Rodina, 2019: 2).

Essential services like water, sanitation, or electricity are produced and delivered by socio-technical systems, and the resilience of these systems is vital for the continued delivery of these essential services. A water supply distribution system constitutes "a network of interconnected pipes and other infrastructure components via which water is conveyed, intermittently stored, and, where necessary, pumped to meet the systems demand and pressure requirements" (Yazdani, Otoo and Jeffrey, 2011: 1576). A resilient water supply distribution system is a significant determinant of sustainable water supply provision; thus, planners and designers must consider system resilience to achieve water supply reliability (Diao, 2021). To describe the relationship between resilience and sustainability, Metaxas and Psarropoulou (2021: 1) assert that "resilience is a way of thinking that would lead to sustainability". Thus, organisations need to adopt systems thinking and consider building organisational capabilities to respond to or deal with system disruptions and building systems with resilience capabilities.

The prepositions of resilience theory support the link between the development of sustainable water supply distribution systems and sustainable water supply services and the need to integrate sustainability into the decision-making process. This provides a relevant lens through which to investigate sustainability integration (or lack thereof) into water supply systems within a municipality.

2.7 CONCLUSION

A systematic literature review elicited relevant conceptual and empirical papers, which were subsequently evaluated concerning the extent and characteristics of sustainability integration and resilient water supply services. Literature suggested mechanisms organisations such as water service utilities can adopt or apply to achieve sustainability in organisational activities and operations and ensure sustainable water supply services. From the various articles and journals, key factors were raised contributing to the propositions, those included (i) Sustainable Water Supply Distribution Systems, (ii) Integration of sustainability in organisation plans and strategies, and (ii) Resilience Thinking - various scholars confirm all these three as having a positive influence towards the achievement of (iv) Sustainable Water Supply services. It emphasises the importance of early integration and the continual incorporation of sustainability principles into organisational practices to achieve long-term sustainability objectives effectively.

CHAPTER 3: RESEARCH METHODOLOGY

3.1 INTRODUCTION

This chapter begins by stating the research aims and objectives and then explains the research paradigm adopted. It further describes the qualitative methodology, including the data-gathering techniques, participants, and sampling techniques. It further describes the data analysis process and moves on to discuss the areas of research validity and reliability. Ethical considerations are also addressed.

3.2 RESEARCH AIM AND OBJECTIVES

The main aim of the research was to evaluate the integration of sustainability principles in an effort to improve the resilience of water supply distribution systems in the ORTDM.

Specific objectives of the study included:

1. To assess the integration of sustainability principles in the municipal water supply distribution systems development programmes.
2. To investigate the challenges and opportunities associated with integrating sustainability principles into water supply distribution systems, as perceived by the municipality.
3. To propose recommendations on how ORTDM can improve the sustainability of water supply services in an effort to improve their resilience.

3.3 RESEARCH PARADIGM

The research adopted a post-positivism paradigm (Ryan, 2006). The paradigm rejects the idea that the researcher can be an independent observer of the social world and is concerned with the subjectivity of reality (Ryan, 2006). Instead of explaining how something works, post-positivists strive to understand why it or people operate as they do (McGregor and Murnane, 2010: 422).

3.4 RESEARCH DESIGN

A qualitative descriptive case study approach was adopted. Qualitative case study research aims to provide a specific understanding of a particular and complex phenomenon based on the ones experiencing it within its real-world context (Yin, 2013). The study was conducted at the ORTDM, situated in Mthatha within the province of the Eastern Cape (South Africa). The qualitative case study research design was chosen to provide an in-depth understanding of the complex and context-specific challenges and opportunities associated with integrating sustainability into ORTDM municipality's water supply distribution systems. This approach allows for the exploration of the intricate interactions between various stakeholders, policies,

and environmental factors within the specific context of the municipality (Ritchie and Lewis, 2003). Additionally, the qualitative design enables the researcher to capture the nuanced perspectives, experiences, and practices of the people involved, which are essential for developing tailored and effective strategies for sustainable water management. The case study method also facilitates the identification of best practices and lessons learned that can be applied to similar contexts, contributing to the broader body of knowledge on sustainable water supply systems in South Africa and beyond. The research methodology adopted in this study is relevant because a single municipality was selected for the in-depth investigation.

3.5 DATA COLLECTION TECHNIQUES

Multiple data sources were used in this research to enable the researcher to gain a comprehensive perspective on integrating sustainability principles in ORTDM. Multiple data sources provide an opportunity to increase the study's trustworthiness and validate and cross-check findings (Morgan, 2022).

Data collection techniques used in this research include document examination (document analysis) and semi-structured interviews with municipal employees. Both document analysis and semi-structured interviews are valuable qualitative research methods that enable researchers to delve into the underlying meanings, perceptions, and contexts associated with their research topics. They provide a holistic view of the subject matter and contribute to a deeper understanding of human experiences and social phenomena. The two data collection techniques used are discussed in the following section.

3.5.1 DOCUMENT EXAMINATION (DOCUMENT ANALYSIS)

Document analysis data collection techniques involve identifying and studying pre-existing documents to gather documented qualitative data and derive insights into the research topic, which may be unveiled through the style and coverage of the document (Ritchie and Lewis, 2003: 35).

Documents identified and analysed in the context of this research include the ORTDM 2020/2021 Integrated Development Plan (IDP) and its 2020/2021 Water Services Development Plan (WSDP). These documents are official municipal documents used as strategic planning instruments to manage and guide all municipality's planning, development, and decision-making processes (Harrison, 2001). Further, the Water Services Development Plan (WSDP) encapsulates all the responsibilities and tasks required of a municipality in water service delivery, including driving sustainable development (Haigh, Fox and Davies-Coleman, 2010). The characteristics and the pivotal role played by the two documents in municipal infrastructure planning, implementation, and management made them key strategic documents to generate

data for this research. The document analysis process included the researcher evaluating the two documents to identify documented strategies and practices pertaining to sustainability integration in ORTDM. The two documents were sourced from the municipal website.

3.5.2 SEMI-STRUCTURED INTERVIEWS

Semi-structured interviews offer a versatile and effective method for eliciting meaningful insights from people's experiences (Kallio, Pietila, Johnson and Kangasniemi, 2016). Semi-structured interviews unique to qualitative research are appropriate for use when the researcher's intention is "to ascertain subjective responses from persons regarding a particular situation or phenomenon they have experienced" (McIntosh and Morse, 2015: 1). Semi-structured interviews involve conducting guided conversations with participants, to gather in-depth information about their experiences, opinions, attitudes, beliefs, and perceptions pertaining the research topic (McIntosh and Morse, 2015). These interviews follow a flexible format, allowing the interviewer and the interviewee to engage in open-ended discussions while following a "predetermined set of questions formulated using an interview guide" (Kallio et al., 2016: 2955). The extensive literature review captured in Chapter 2 led to the formulation of the interview schedule, with interview questions used during the semi-structured interviews as the primary data-gathering tool (see Appendix A).

The semi-structured, in-depth, face-to-face interviews were used to collect data from the seven participants at ORTDM Offices. The interviews were conducted from the 17th of May to the 24th of May, 2023. The interview questions focused on gaining a comprehensive perspective of the municipal employees on sustainability integration in ORTDM. Interview data was digitally recorded using the Otter.ai tool, after which the data was transcribed and converted into text (Da Silva, 2021). The audio equipment was pre-tested by conducting a pilot interview to ensure the accuracy of the transcripts produced during the interview (Morse, 1991: 120).

3.5.2.1 SAMPLING TECHNIQUES

Purposeful sampling method was used to select the data sources (Patton, 2002). Purposeful sampling aims to locate and "select data sources that are rich in information" and have a complete understanding and knowledge of the subject matter (Patton, 2002: 273). These could be subject-specific documents or professionals and individuals who understand the context of the research or research challenge. For this study, municipal documents containing information about water services and municipal officials working in the water services unit with rich knowledge about the water business in ORTDM were purposefully selected.

3.5.2.2 RESEARCH PARTICIPANTS

Compared to quantitative research, qualitative research sample sizes are generally smaller (Patton, 2002). The researcher had planned a sample size of 12 participants from ORTDM; however, only seven participated in the study. This is a participation rate of 58%, which is sufficient for qualitative research (Mthuli, Ruffin and Singh, 2022). The seven interviewees from ORTDM comprised municipal officials selected from the water and sanitation services delivery department.

3.6 DATA ANALYSIS

Data was derived from municipal documents and interview transcripts (responses). Data analysis was conducted using the deductive thematic analysis method (Braun and Clarke, 2006). According to Braun and Clarke (2006), deductive thematic analysis involves analysing qualitative data, such as interview transcripts, field notes, or textual documents, with a predetermined set of theoretical propositions or concepts derived from existing literature or established theories. In this research, the purpose was to "identify, analyse, and report patterns (themes) within the data" (Braun and Clarke, 2006: 82), derived from the semi-structured interviews conducted in ORTDM as well as from the municipal documents. This approach aims to explore and identify patterns and themes in the data that align with the predetermined theoretical framework (Pearse, 2019). Braun and Clarke (2021) further state that thematic analysis can provide analyses of people's experiences concerning issues or the factors and processes that underlie and influence a particular phenomenon, thus making it suitable for a qualitative case study.

The deductive qualitative nature of the research required that the researcher engages with relevant literature related to the integration of sustainability within the context of the study, as "the theory or concepts derived from the literature form the basis of analysis" (Braun and Clarke, 2006: 92). The above background served as a foundation for the researcher to adopt the deductive thematic data analysis procedure method.

The data analysis process elicited information regarding strategies and practices ORTDM employs to promote or enhance sustainability integration. Collected data was then categorised based on sustainability principles identified as themes in the study. Identified evidence from documents and responses from interview transcripts were placed against the corresponding sustainability principle. Secondly, the analysis elicited data from the two sources used in this research to identify challenges and opportunities in integrating sustainability in ORTDM.

3.7 DATA VALIDITY AND RELIABILITY

Data reliability and validity are key for attaining rigour in qualitative research (Morse, Barret, Mayan, Olson and Spiers, 2002). Leung (2015: 325) defines validity in qualitative research as "the appropriateness of the tools, processes, and data". Data triangulation is a recommended method to enhance the study quality and credibility of the research process (Ritchie and Lewis, 2003: 275). Data was collected through semi-structured interviews and critical evaluation of municipal documents pertinent to infrastructure planning and development to enhance the validity of qualitative research (Voce, 2005).

The terminology and focus on reliability differ between quantitative and qualitative research. Reliability in quantitative research "is generally understood to concern the replicability of research findings and whether or not they would be repeated if another study using the same or similar methods was undertaken" (Ritchie and Lewis, 2003: 270). However, in qualitative research, the traditional concept of reliability is often replaced with concepts such as trustworthiness or dependability, which align better with the qualitative research paradigm (Ritchie and Lewis, 2003: 271).

Dependability refers to the consistency and stability of the research process (Guba, 1981: 81). It involves documenting the research procedures and decisions made during the study so that others can evaluate the rigour of the research process (Guba, 1981: 87). To ensure the dependability of the research process and findings, with the permission of the interviewee the interview proceedings were digitally recorded, and the researcher took notes documenting key issues important to the study, raised by the interviewee. The recordings assisted the researcher during the data analysis stage of the research.

3.8 ETHICAL CONSIDERATION

Rhodes University's Ethics Committee approved the researcher's research proposal, and subsequently, the researcher obtained ethical clearance – Approval Reference: 2023-7017-7496 (see Ethics Approval letter in Appendix E). After receipt of ethics clearance, permission was obtained from the municipal manager to conduct the research in the district municipality and to interview municipal officials from the water and sanitation services delivery department (see Appendix B).

The researcher utilised an appropriate letter of consent and adhered to the code of ethics as outlined in Rhodes University's 'Guide for Master's & Doctoral Student - 2019' on how to conduct research in an ethically appropriate manner to maintain a high standard of responsibility and integrity (Rhodes University, 2019).

Interviewees were asked to sign a consent form agreeing to participate in the study before the commencement of the interview (see Appendix C). The letter stated the high-level purpose of the research, the estimated duration of the interview, and the assurance that no personal details would be shared or disclosed in the research report. The consent form also asked the interviewees for permission to allow the interview to be recorded.

3.9 CONCLUSION

In summary, the research methodology chapter outlined the adoption of a qualitative research approach within a post-positivism paradigm. It described the data collection and analysis techniques, emphasised triangulation for research validity, and underscored the ethical considerations and processes followed throughout the study. The selected methodology not only ensured a comprehensive understanding of the research problem but also facilitated the exploration of diverse perspectives. The approach was carefully chosen to align with the study's objectives, providing a robust framework for capturing the complexities of the subject matter. The following chapter presents the research findings and a discussion, where the outcomes of these methodological choices are critically analysed in light of the study's aims and theoretical framework.

CHAPTER 4: RESEARCH FINDINGS AND DISCUSSION

4.1 INTRODUCTION

This chapter presents and discusses the research study's findings from interviews and document data to address the research objectives described in previous chapters. The research objectives achieved were:

1. To assess the integration of sustainability principles in the municipal water supply distribution systems development programmes.
2. To investigate the challenges and opportunities associated with integrating sustainability principles into water supply distribution systems, as perceived by the municipality.

As discussed in Chapter 3, semi-structured interviews and examination of relevant municipal documents related to infrastructure planning and development were used for data collection. The semi-structured interviews were conducted with seven officials from ORTDM. These were officials purposely selected because of their knowledge and expertise in water services planning and development. The details of the participants are presented below:

Table 1: Research Participants

RESPONDENT NUMBER	PROFESSIONAL BACKGROUND	INTERVIEW PLATFORM
1	Facilities Management	Face–to–Face
2	Project Management	Face–to–Face
3	Engineering Design Management	Face–to–Face
4	Water Services Management	Face–to–Face
5	Project Management	Face–to–Face
6	Project Management	Face–to–Face
7	Project Management	Face–to–Face

Regarding document selection and data collection, the Integrated Development Plan (IDP) and Water Services Development Plan (WSDP) were used. The municipal IDP and the WSDP guide the municipal planning process for a Water Services Authority (WSA). The process of developing the two documents is further guided by various legislative prescripts such as the National Environmental Management Act (Act 107 of 1998) and the Water Services Act (Act No. 108 of 1997). Therefore, the ORTDM IDP (2020/2021) and the WSDP (2020/2021) documents were analysed, and findings are presented and discussed.

The discussions are divided into two parts. The first part delves into the findings associated with integrating sustainability principles in ORTDM, whereas the second part centres on the findings associated with sustainability integration challenges and opportunities in ORTDM.

4.2 THE INTEGRATION OF SUSTAINABILITY PRINCIPLES IN ORTDM

The presentation and discussion align with the themes introduced in Chapter 2 and the sub-themes that emerged during this research.

4.2.1 SOCIAL SUSTAINABILITY INTEGRATION

The ORTDM IDP (2020/2021) and ORTDM WSDP (2020/2021) documents were examined to identify information about how ORTDM integrates social sustainability. To complement the qualitative data information from the ORTDM IDP (2020/2021) and ORTDM WSDP (2020/2021) documents, participants were asked questions to gain perspectives on practices, policies, and strategies employed by ORTDM for integrating social sustainability.

Specifically, the seven participants were asked to express their opinions on how the municipality's current water services planning and implementation strategies and processes contribute to (i) Promoting proactive stakeholder participation, (ii) Promoting improved quality of life of communities, (iii) Promoting the realisation of the right of fair access to water resources and water services, and (iv) Promoting equitable distribution of water infrastructure.

i) Promote proactive stakeholder participation

Most respondents perceived using the IDP development process and the establishment and involvement of communities in Project Steering Committees (PSCs) as a way to promote stakeholder participation. For example, Respondent 7 said, "…. *OR Tambo during IDP road shows, allows the public to participate….and during the time of project implementation, ISD Consultants are appointed to ensure that they establish PSCs, where the PSC forms part of the discussions on project matters during project implementation*". Further, Respondent 2 said, "*……every stakeholder around the development is contacted, through community mobilisation to promote community participation*". While Respondent 3 said, "…*We even go to those areas where the actual resource is, and then we make sure that we do consult with the ward councillor, the local chief, all the leadership of that particular area in terms of their views and as part of their participation*….", suggesting that those that are affected or have an interest in project developments participate, specifically during planning.

One of the ORTDM interviewees stated the following concerning the promotion of stakeholder participation:

"*…the challenges that we are encountering are the budget limitation and the lack of skills inside, as we do not have inside skills to monitor…"* (Respondent 7).

The ORTDM IDP (2020/21) and the ORTDM WSDP (2020/21), on the other hand, did not have specific statements indicating how the municipality promotes proactive stakeholder participation. Further, the level of involvement of stakeholders and their management process is not highlighted by either the respondents or the two municipal documents.

From the findings above, it emerged that ORTDM has strategies and practices that involve using the IDP development process to promote stakeholder participation. However, this sentiment could not be confirmed in the analysed key documents as there were no specifics on promoting stakeholder participation. The non-inclusion of specific statements suggests a gap in the ORTDM IDP development process and its effectiveness in encouraging stakeholder participation. The limited financial resources and internal skills shortage required to undertake stakeholder participation activities, highlighted during interviews and reflected in the IDP, further cast doubts on the effectiveness of strategy implementation by ORTDM.

ii) Promote improved quality of life in communities

Respondents 1–7 responded by stating that as a strategy, ORTDM, during project implementation, focuses on ensuring equitable participation of local stakeholders. The process includes promoting local job creation by involving local labour, engaging local Small, Medium, and Micro Enterprises (SMMEs) in the project, and encouraging the participation of local businesses. These efforts aim to enhance local economic development in the project area, ultimately benefiting the community where the project is being implemented. For example, Respondent 1 said, "…. *once the project starts, there is employment generation whereby the local people are being employed, and the local resources are being utilised around that area*".

Information found in the ORTDM IDP (2020/21) regarding the municipality's intentions and commitment to improving the quality of life of its communities stated:

"*The municipality will implement strategies and commit resources to address the triple challenges of poverty, inequality, and unemployment in pursuit of its vision to be a people-centred, vibrant, innovative and prosperous district"* (ORTDM IDP. 2020/2021).

Further, information found in the ORTDM IDP (2020/21) regarding the ORTDM's level of inequality stated:

"In 2020, the Gini coefficient in O.R. Tambo District Municipality was at 0.581, which reflects an increase in the number over the ten years from 2010 to 2020. The Eastern

Cape Province and South Africa both had an unequal spread of income amongst their residents (at 0.634 and 0.639 respectively) when compared to O.R. Tambo District Municipality" (ORTDM IDP. 2020/2021).

From the findings above, there is evidence that ORTDM has strategies and practices to address poverty, inequality, and unemployment and improve the quality of life of ORTDM communities. Additionally, the findings revealed ORTDM's plan to involve Small, Medium and Micro Enterprises (SMMEs) during project implementation as a contributor to income generation for businesses, thereby enhancing the well-being of communities despite the temporary nature of construction projects. However, The Gini Coefficient above, which serves as an indicator of inequality, suggests that the level of inequality among the citizens of ORTDM has not exhibited a decrease towards values indicative of equality. This observation highlights the inadequacy of the municipality's strategies and practices in improving the lives of its communities.

iii) Promote the realisation of the right of fair access to water resources and water services

In their responses, Respondents 2, 3, 4, 5, 6, and 7 all stated that ORTDM implements projects in line with legislative prescripts guiding the provision of water services by Water Services Authorities, emphasising the alignment of the ORTDM's water provision strategies to the legislative requirements. For example, Respondent 2 said, "….*the standpipes are accessible to the general public, whereby everyone has a right to get that particular potable water".* Meanwhile, Respondent 7 highlighted the use of legislative frameworks that require a non-discriminatory approach to water services provision as tools to ensure fair access to water resources and water services. The words used by Respondent 7 were, "*The right for fair access ORTDM ensures that it abides with chapters two and twelve of the Constitution and that all people have access to a basic level of service*".

Meanwhile, information found in the ORTDM IDP (2020/21) and ORTDM WSDP (2020/21) stated:

"*As a water services authority, the municipality commits to implementing projects that bring water and sanitation service to its communities, which for decades were deprived access to these services*" (ORTDM IDP, 2020/2021: 43).

"*The Statistics South Africa: Community Survey 2016 (Stats SA, 2016b) reveals that 40% of households had access to potable water (household connections, communal stands and water tankers), and 77% had access to flush, Ventilated Pit Latrines and chemical toilets*" (ORTDM WSDP, 2020/2021: 15).

The findings above revealed information on the use of legislative frameworks in ORTDM. They confirmed the intentions of the municipality to provide water services across the district in a manner that will ensure even those previously not serviced would benefit, thus ensuring the realisation of the right of fair access to water resources and water services. However, findings also revealed that the municipality still needs to achieve universal access to water services, reflecting poor implementation of water provision strategies by ORTDM.

iv) Promote equitable distribution of water infrastructure

Respondent 2, Respondent 3, Respondent 5, Respondent 6 and Respondent 7 alluded that projects planned and implemented by ORTDM adhere to water provision policy guidelines. For example, Respondents 2, 6 and 7 said, "*…the project is implemented at an RDP standard whereby everyone will get water; it is not a household connection*,..", "*… in terms of making sure that there is fair distribution, especially with regard to water supply, there is this policy, that is called the RDP standard, so we are using that one because it regulates how the municipality should distribute and allocate the standpipes within the community. So we are using the RDP standard, which prescribes a 200-meter walking distance for households, meaning that all the communities are allowed to walk a maximum of 200-meter distance to a standpipe*…." and, "*...in terms of fair distribution, ORTDM ensures services are equally distributed*", respectively.

Information found in the ORTDM WSDP (202021) stated:

> "*In the O.R. Tambo, the minimum service level for water is regarded as water supply facility within 200m of dwelling delivering at least 25 litres per person per day 6kl/hh/month in the case of yard or house connections*" (ORTDM WSDP, 2020/21: 15).
>
> "*Topography of the area makes it expensive for some areas to be serviced*" (ORTDM WSDP, 2020/21: 23).

Findings revealed that the Reconstruction and Development Programme (RDP) policy guidelines were utilised as legislative directives and policy frameworks, as evidenced through interviews and supported by data from the ORTDM WSDP (2020-21). These guidelines were employed to guide the distribution of water infrastructure and the provision of water services within the municipality. However, the findings also revealed that ensuring equitable distribution of water infrastructure in ORTDM is compromised by the district's topography and vastness.

4.2.1.1 DISCUSSION ON SOCIAL SUSTAINABILITY INTEGRATION

This study's findings revealed gaps and misalignments between the practices and strategies utilised by the ORTDM to integrate social sustainability in its water supply distribution systems programmes. Major contributing factors that compromise the effectiveness of the ORTDM strategies and practices include the lack of explicit consideration of social sustainability principles in municipal key strategic documents such as the IDP and WSDP, alongside the highlighted budgetary constraints and the shortage of internal skills. Further, the high rate of inequality and the high number of households still without access to water services, especially in rural areas, reflects ORTDM's inability to fully implement strategies to foster the integration of social sustainability principles.

The research by Sartori and Catalano (2013) supports ORTDM's approach of fostering job creation through infrastructure development initiatives as a means to enhance social sustainability. Their study reveals a positive correlation between infrastructure investments and well-being, highlighting that projects tailored to meet local needs inherently improve living standards. Specifically, investments in water and sanitation infrastructure lead to improvements in drinking water quality, supply reliability, environmental preservation, and overall health, thus contributing to an enhanced quality of life (Sartori and Catalano, 2013: 18). This emphasises the importance of directing resources towards infrastructure development to uplift community livelihoods. Further, the ORTDM use of IDP development processes as a tool to promote stakeholder participation aligns with Ababio's (2004) research findings, which corroborates the IDP's suitability as a mechanism for municipal involvement of communities in planning and decision-making as mandated by the Municipal Systems Act of 2000.

However, challenges such as limited expert personnel and financial resources pose barriers to the effective strategy implementation within ORTDM, a sentiment also echoed in the findings of Buluma, Keror and Bonuke (2013: 84). Their research on water sector agencies in Kenya also identified lack of financial resources and expertise as detrimental to strategy implementation, further recommending that timely allocation of adequate funds to local authorities is essential for the swift execution of council strategic plans

4.2.2 ENVIRONMENTAL SUSTAINABILITY INTEGRATION

The ORTDM IDP (2020/21) document has been examined to identify information about how ORTDM integrates environmental sustainability. To complement the qualitative data information from the ORTDM IDP (2020/21) document, participants were asked questions to gain their perspectives on practices, policies, and strategies employed by ORTDM for integrating environmental sustainability.

Specifically, the seven participants were asked to express their opinions on how the municipality's current water services planning and implementation strategies and processes contribute to (i) Promoting the avoidance of adverse effects on natural resources, (ii) Promoting efficient exploitation of natural resources, and (iii) Promoting the implementation of environmental protection and restoration programmes.

i) Promote the avoidance of adverse effects on natural resources

Six respondents considered the use of the Environmental Impact Assessment (EIA) and the appointment of environmental consultants by ORTDM as means to promote the avoidance of adverse effects on natural resources. For example, Respondents 5 and 7 said, "…*we appoint external environmental consultants who will be there to assist us in terms of monitoring the contractor that is appointed",* and "… *O.R. Tambo conducts an Environmental Impact Assessment to outline potential risks that may emanate during project implementation. Also, it conducts a ROD to help manage these risks when they occur*", respectively.

Information found in the ORTDM IDP (2020/21) supporting the notion of the existence of strategies and practices to promote the avoidance of adverse effects on natural resources stated:

> *"ORTDM Environmental Impact Assessment (EIA) monitoring team plays an important role in the framework for the monitoring of conditions set in the ROD (Record of Decision) and Environmental Management Plan (EMP) during project implementation and operation"* (ORTDM IDP, 2020/21).

The findings from interviews and key municipal documents reveal that the ORTDM has strategies and practices to avoid adverse effects on natural resources. However, the findings also revealed that the ORTDM has limited internal capacity regarding environmental management officers with experience and expertise. Hence, it appoints external environmental consultants to complement the municipal capacity to prepare studies and reports such as an Environmental Impact Assessment (EIA) and Environmental Management Plan (EMP), facilitate the application of a Record of Decision (ROD), as well as assist in monitoring contractors for compliance with ROD and EIA requirements during the construction stage. The mentioned limitations suggest that ORTDM has difficulties in implementing its strategies.

ii) Promote efficient exploitation of natural resources

Except for Respondent 1, all other respondents quoted adhering to the recommendation of the water use license and ROD as a strategy ORTDM employs to promote efficient exploitation of natural resources. For example, Respondent 7 said, "…. *in every water project during the planning stage, O.R. Tambo has to contact or work with DWS to apply for a water use license*

that will determine the amount of water to be abstracted and to avoid the over-abstraction of water from that water resource".

Reflected in the ORTDM IDP (2020/21) is a statement indicating a limitation in ORTDM's efforts to promote the efficient exploitation of natural resources:

> "*Since the early years of implementing Integrated Environmental Management (IEM) in South Africa, post-Environmental Impact Assessment follow-up and project monitoring has not been done. However, the emphasis of environmental policy is moving towards compliance monitoring*" (ORTDM IDP, 2020/21: 87).

The findings derived from interviews and key municipal documents reveal that the ORTDM has strategies and practices to promote the efficient exploitation of natural resources. One of the practices is applying for a water use license from the Department of Water and Sanitation (DWS) to obtain a permit for water abstraction. However, the findings also revealed that the ORTDM has not been conducting post-environmental impact assessment follow-ups or monitoring projects once construction is completed as part of the Integrated Environmental Management (IEM) process. However, its focus has been on ensuring compliance with the legislative mandates and permits during planning and construction stage activities. The above suggests that ORTDM is fully implementing its strategies.

iii) Promote the implementation of environmental protection and restoration programmes

Six respondents considered ensuring compliance with the EIA requirements that guide environmental restoration measures, such as re-grassing, to promote implementing environmental protection and restoration programmes by ORTDM. For example, Respondent 6 said, "…. *we rehabilitate the areas where we have disturbed the environment, like when we were digging trenches, we backfill and also make sure that we plant grass on top and on-site*".

However, a statement in the ORTDM IDP (2020/21) suggests that ORTDM has several challenges that compromise its ability to fully implement environmental protection and restoration programmes even though it employs EIA procedures to manage and monitor environmental impacts. A statement found in the ORTDM IDP (2020/21) supporting this view stated:

> "*While rich in natural, cultural and historical resources, O.R Tambo District Municipality is also faced with several challenges, such as redressing past inequities and apartheid legacies, the need for housing, especially along the wild coast, unemployment and poor service delivery. The growing needs of the increasing*

population in ORTDM have also resulted in a growing demand for development" (ORTDM IDP, 2020/21: 86).

"*As mandated by the Biodiversity Act, O.R Tambo District Municipality has advertised for the development of the Biodiversity Sector Plan that will detail threats, opportunities and advantages of protecting our biodiversity. As much as the district has not done much on the function, most of the biodiversity assets are protected through the EIA process and taken care of by the process*" (ORTDM IDP, 2020/21: 86).

Further, ORTDM could only manage to monitor a limited number of projects implemented by the municipality per quarter, leaving other projects from their project list unattended. A statement in the ORTDM IDP (2020/21) reflects this observation:

"*O.R. Tambo has a KPA to monitor at least 20 MIG projects implemented within the district per quarter. So far, the district has managed to monitor and assess at least 40 MIG projects that have been implemented. Monitoring is a continuous process, and so far, the district has not picked up any serious environmental implications caused by the construction of projects. All the projects are still compliant, and no project had serious non-compliance to the license conditions*" (ORTDM IDP, 2020/21: 87).

The interviews and the key municipal documents revealed that ORTDM uses structured processes, like the Environmental Impact Assessment (EIA), to guide environmental restoration measures such as re-grassing. Further, the Integrated Development Plan (IDP) document contains statements on using the EIA process to institute measures to protect biodiversity amidst the growing population and need for development in the coastal areas of ORTDM. The findings also revealed that the ORTDM does not have a Biodiversity Sector Plan and also experiences challenges, including the lack of internal expertise to manage, monitor and ensure all infrastructure developments are planned and executed in a manner that is not harmful to the environment. Consequently, ORTDM could only manage to monitor a limited number of projects implemented by the municipality per quarter, leaving other projects from their project list unattended. These limitations suggest that ORTDM is unable to implement its strategies to ensure the implementation of environmental protection and restoration programmes.

4.2.2.1 DISCUSSION ON ENVIRONMENTAL SUSTAINABILITY INTEGRATION

This study's findings revealed limitations and misalignment between the practices and strategies utilised by ORTDM to integrate environmental sustainability in its water supply

distribution systems programmes. The major contributing factors include ORTDM's limited internal expertise and experience in successfully implementing municipal strategy, resulting in ORTDM engaging external service providers to monitor project implementation programmes. Also, the findings revealed that the unavailability of Biodiversity Sector Plans and the lack of Environmental Management Officers attached to the infrastructure department responsible for implementing infrastructure projects compromises the effective implementation of ORTDM strategies. Thus rendering ORTDM unable to avoid adverse effects on natural resources entirely. Further exacerbating the challenge is the growing number of people in ORTDM, which results in an ever-increasing need for development, thus putting strain on natural resources and negatively impacting the ecosystem and biodiversity.

Overall, the strategies and practices employed by ORTDM to integrate environmental sustainability are negatively affected by challenges such as (i) Limited internal expertise, (ii) One dimensional-orientated environmental management strategies focusing only on the use of EIA as a compliance tool, (iii) Growing population and infrastructure needs, (iv) Lack of environmental management plans, and (v) Ineffective policy implementation strategies. As a result, these factors render the ORTDM ineffective in fully implementing strategies to foster the integration of environmental sustainability.

The research findings of Bruhn-Tysk and Eklund (2002), using the case of Swedish biofuel plants, validate the strategic approach taken by ORTDM to utilise Environmental Impact Assessment (EIA) processes as a legislative tool for managing environmental impacts within its infrastructure development programmes. This confirms the effectiveness of EIAs in promoting sustainable development when implemented correctly. However, Labuschagne and Brent (2005) emphasise in their study that relying solely on EIAs to address environmental concerns is a common practice in developing countries like South Africa. This perspective implies that exclusively relying on EIAs may not suffice to mitigate environmental degradation within ORTDM's operations, requiring a more holistic approach that considers "global effects and effects on the management of natural resources" (Bruhn-Tysk and Eklund, 2002: 129).

Furthermore, Tsibani's (2007) findings highlighted the challenge faced by municipalities acting as Water Services Authorities (WSAs) in South Africa, revealing their insufficient capacity to effectively meet the legislative obligation of providing water to citizens. A similar challenge was identified within ORTDM regarding the absence of environmental management officers tasked with ensuring infrastructure projects do not harm the environment. The barriers to effective strategy implementation found in ORTDM are consistent with Nkosi's (2015: 33) study on strategy implementation in a South African local municipality in the province of Mpumalanga.

4.2.3 ECONOMIC SUSTAINABILITY INTEGRATION

The ORTDM WSDP (2020/21) and ORTDM IDP (2020/21) documents have been examined to identify information about how ORTDM integrates economic sustainability. To complement the qualitative data from the ORTDM WSDP (2020/21) and ORTDM IDP (2020/21) documents, participants were asked questions to gain their perspectives on practices, policies, and strategies employed by ORTDM for integrating economic sustainability.

Seven participants were asked to express their opinions on how the municipality's current water services planning and implementation strategies and processes contribute to (i) Ensuring the use of economic capital is on developments that will not cause irreversible damage to the natural resources, (ii) Ensuring financial investments made in developments will not compromise the financial position of the municipality, (iii) Encouraging efficient management and use of financial resources.

i) Ensuring the use of economic capital is on developments that will not cause irreversible damage to the natural resources

Most respondents mentioned adhering to EIA requirements, transitioning from diesel-powered pumps to electric pumps, and conducting feasibility studies as approaches the municipality uses to ensure that economic capital is directed toward developments that do not cause irreversible damage to natural resources. For example, Respondents 2 and 6 said, "*...previously, some of the water schemes used diesel pumps to pump water to the reservoirs, so that was a lot in terms of cost because diesel pumps consume a lot of diesel, and it is costly…..then the municipality resorted to saying diesel pumps would be changed to electric pumps….*" and "*.... We do the feasibility studies…also, in terms of the irreversible damages to natural resources because when we perform these feasibility studies, we also engage environmental consultants that make sure that these projects we will be doing, they do not impact negatively to our environment, like the **EIA** that we do*", respectively.

Information found in the ORTDM IDP (2020/21) document highlighting commitments by ORTDM to ensure the use of economic capital is on developments that will not cause irreversible damage to the natural resources stated:

> *"O.R. Tambo recognises that, although development must be economically and socially acceptable, the development challenges in O.R. Tambo DM must be addressed in an environmentally sustainable manner"* (ORTDM IDP, 2020/21).

Findings from the interviews and the key municipal documents revealed that ORTDM uses structured processes like the Environmental Impact Assessment (EIA) and conducts feasibility studies to ensure economic capital is used on developments that will not cause irreversible

damage to natural resources. Further, despite the need for development, ORTDM emphasises that projects should be done sustainably and environmentally.

ii) Ensuring financial investments made in developments will not compromise the financial position of the municipality

The majority of respondents mentioned the appointment of external technical consultants for monitoring project costs, carrying out feasibility studies to evaluate the development project's viability, and using EIA to guide works to avoid the risk of costly legal or remediation expenses resulting from environmental damage caused by development. For example, Respondents 6 and 7 said, "*..We do feasibility studies before we implement projects, which assist the municipality in seeing if those projects will be sustainable and if the municipality will afford to maintain them in the near future*…." and "*… The municipality employs or appoints technical consultants to ensure that during project implementation, they measure the work done as per the bill of quantities to ensure that when we pay, we pay only for the work done. There is no budget overrun*", respectively.

Further, information found in the ORTDM IDP (2020/21) document highlighting policies and plans considered in ORTDM to ensure financial investments made in developments do not compromise the financial position of the municipality stated:

> "*Promoting radical economic transformation and creating vibrant communities. The district has embarked on several Economic programs to ensure an Economy that Grows with its People – An Economy for Jobs*" (ORTDM WSDP, 2020/21).
>
> "*Public services should be provided economically and efficiently to give citizens the best possible value for money"* (ORTDM IDP, 2020/21).

Regarding ensuring financial investments made in developments will not compromise the municipality's financial position, the findings above reveal that the ORTDM uses structured processes like conducting work done inspections and measurements and conducting feasibility studies to ensure project economic viability. Lastly, ORTDM has policies that encourage efficient use of financial resources to ensure communities receive value for money.

iii) Encouraging efficient management and use of financial resources

The majority of the respondents viewed the practice of project implementation monitoring and construction work done evaluation and certification conducted by ORTDM Project Managers, supported by appointed technical engineering consultants, as a strategy used by ORTDM to encourage efficient management and use of financial resources. For example, Respondents 6 and 7 said, "…*we do have people in the Project Management Unit, making sure that there are*

no costs that the municipality will end up paying extra over and above what has been approved on the project", and "*…we pay only for the work done and make sure there is no budget overrun*", respectively.

Information found in the ORTDM IDP (2020/21), stated:

> "*ORTDM is classified as a high-capacity municipality. This requires the municipality to be fully compliant with Generally Recognised Accounting Practice (GRAP), Municipal Financial Management Act (MFMA) compliance issues and all its related circulars and regulations"* (ORTDM IDP, 2020/21: 107).

Further, information found in the ORTDM IDP stated:

> "*The municipality obtained a Qualified Audit Opinion in the 2018/19 financial year*" (ORTDM IDP, 2020/21: 192).

Regarding encouraging efficient management and use of financial resources, the findings above reveal that the ORTDM uses the Municipal Financial Management Act, 2003 (Act 56 of 2003) to ensure sound financial management. Further findings indicate that ORTDM employs strategic practices, including project work done evaluation and certification, to ensure efficient management and use of financial resources. However, ORTDM received a qualified audit opinion for the 2018/19 financial year and again in the 2019/20 financial year, reflecting non-compliance with MFMA and GRAP requirements. These findings suggest that the ORTDM has been unable to ensure efficient management and use of financial resources.

4.2.3.1 DISCUSSION ON ECONOMIC SUSTAINABILITY INTEGRATION

This study revealed that the ORTDM implements strategies, practices, and financial management policies consistent with economic sustainability integration. The ORTDM's commitment to conducting comprehensive feasibility studies emerged as a recurrent theme, demonstrating a proactive approach to assessing the viability of development projects and avoiding potential financial risks. Moreover, the appointment of external project managers was also acknowledged as a strategic measure, reinforcing the commitment to overseeing construction projects meticulously and ensuring strict adherence to project specifications and budgetary allocations. However, the poor audit opinion the municipality has been getting over the years reflects a gap in its implementation of financial management policies. The poor audit outcomes, limited internal expertise with experience to successfully monitor project implementation, and increased reliance on external consultants could imply that the municipality is unable to implement strategies to foster the full integration of economic sustainability.

The ORTDM's struggle with limited internal expertise and recurring poor audit results, identified as key obstacles to successfully implementing its strategies, aligns with the conclusions drawn by Aadnesgaard and Willows (2016). Their research on South African municipalities established a correlation between a municipality's poor audit outcomes and its shortcomings in water provision (Aadnesgaard and Willows, 2016: 551). These findings imply that because ORTDM consistently receives unfavourable audit outcomes, often linked to inadequate competent personnel, inadequate financial management and implementation of financial policies (Mnguni and Subban, 2022: 144), its strategies, including the economic and sustainable provision of water to communities, are not achieving their intended effectiveness.

4.2.4 ENGINEERING SUSTAINABILITY INTEGRATION

The ORTDM WSDP (2020/21) and ORTDM IDP (2020/21) documents have been examined to identify information about how ORTDM integrates engineering sustainability. To complement the qualitative data information from the ORTDM IDP (2020/21) and ORTDM WSDP (2020/21) documents, seven participants were asked questions to gain their perspectives on practices, policies, and strategies employed by ORTDM for integrating engineering sustainability.

Specifically, the seven participants were asked to express their opinions on how the municipality's current water services planning and implementation strategies and processes contribute to (i) Facilitating the delivery of durable water supply distribution systems, (ii) Ensuring the availability of operation and maintenance, (iii) Ensuring the choice of infrastructure technology improves water supply reliability, and (iv) Ensuring the choice of infrastructure technology that promotes economic efficiency.

i) Facilitate the delivery of durable water supply distribution systems

The use of infrastructure standard design guidelines was mentioned as a mechanism to facilitate the delivery of durable water supply distribution systems by Respondent 2 and Respondent 3. For example, Respondent 2 said, "… *We are using the standard designs for our supply, that is, the pumps, the pipes, and other things, the other components of the materials*…". Additionally, the appointment of technical and environmental consultants for conducting feasibility studies and conducting material testing were noted as strategies and practices within ORTDM to facilitate the delivery of durable water supply by Respondent 4, Respondent 5, Respondent 6 and Respondent 7. For example, Respondent 6 and Respondent 7 said, "…*before we implement these projects, we engage the service providers like the engineering consultants and environmental consultants…they prepare feasibility studies, and they will propose to the municipality the type of infrastructure that will be relevant for that particular project*..." and

"…*We also conduct tests to ensure that our project is durable during implementation…*", respectively.

However, information found in the ORDTM WSDP (2020/21) reflects that delivering durable water infrastructure in ORTDM is a challenge due to its rural nature:

> "*The population in ORTDM is predominantly rural (88.3%)*" (ORTDM WSDP. 2020/21: 114).
>
> "*The remote nature of much of the infrastructure requires the employment of community-based labour to undertake basic 'day to day' operational tasks*" (ORTDM WSDP, 2020/21).

The findings above highlighted strategies and practices used in ORTDM to achieve the delivery of durable water supply distribution systems. These practices include adherence to standard design guidelines and standards, collaboration with reputable technical and environmental consultants and conducting rigorous material testing procedures. These efforts are intended to collectively contribute to the sustainability and long-term viability of the municipality's water supply services. However, a statement in the ORTDM WSDP (2020/21) further suggests that ensuring the delivery of durable water supply distribution systems in ORTDM is compromised by the rural nature of the district.

ii) Ensure the availability of operation and maintenance

The majority of the respondents mentioned the appointment of external service providers on contract to undertake the operations and maintenance (O&M) function on behalf of ORTDM as a strategy–to ensure the availability of O&M capabilities. For example, Respondents 2, Respondent 3 and 7 said, "*…within the OR Tambo, we have got a section that is dealing with operation and maintenance; the challenge is, we are still understaffed due to budget constraints…", "…in terms of the human capital when it comes to operations and maintenance, we rely on service providers to do that. So our internal staff does not even do the maintenance on our assets…."* and *"…OR Tambo in response to these challenges has employed term contracts to assist in the supply of materials required in doing operations and maintenance….",* respectively.

However, Respondent 3, Respondent 4, Respondent 5 and Respondent 6 mentioned limitations in ensuring the availability of operations and maintenance. Limitations include limited budget, shortage of mechanical and electrical expertise, delays in procurement of operations and maintenance parts, and lack of standardisation in infrastructure technologies. For example, Respondent 3 and Respondent 6 stated that "…..*the municipality has got a shortage or lack in*

terms of the operational budgets…..", "*….when you go out to our communities and look at these projects, you will find that the technology that is used will be different from project to project which makes it very difficult for our operation and maintenance guys to operate these schemes*", suggesting that the lack of standardisation in infrastructure technologies presents a challenge for ORTDM in maintaining its infrastructure.

Further, information found in the ORDTM IDP (2020/21) and ORDTM WSDP (2020/21) confirming the above limitations from the interviews stated:

> "*The lack of an Operations and Maintenance Plan in ORTDM needs to be addressed*" (ORTDM WSDP, 2020/21: 87).
>
> "*The District Municipality needs to develop an operation and maintenance plan to address capacity issues, skills and necessary support equipment and tools to deal with its infrastructure asset base*" (ORTDM IDP, 2020/21).
>
> "*The road network is poor (mostly gravel roads), with the result being that quick and efficient maintenance is difficult. These harsh conditions also increase the cost of running the fleet of vehicles necessary for effective O&M*" (ORTDM WSDP, 2020/21).

The findings above revealed that the ORTDM has no operations and maintenance plan and uses different infrastructure technologies. This makes the municipality unable to sustain the functionality of its water infrastructure and quickly respond to water infrastructure breakdowns. This shortcoming leads to delays in attending to water interruptions. As a result, the municipality losses much revenue, crippling municipal financial sustainability due to unbilled water from unattended leaks. The findings from the interviews highlighted strategies and practices used in ORTDM to ensure the availability of operations and maintenance. These practices include establishing an in-house operations and maintenance unit and appointing external service providers to provide maintenance capabilities on term contracts. However, findings from interviews and key municipal documents also reveal that budget constraints compromise these efforts, such as using different infrastructure technologies, delays in procurement, poor road infrastructure, and shortage of personnel in the operations and maintenance unit.

iii) Ensure the choice of infrastructure technology improves water supply reliability

On ensuring the choice of infrastructure technology improves water supply reliability. Respondents 2 and 6 considered the shift from using diesel-powered stand-alone water schemes to building regional schemes with electric pumps as an appropriate strategy for the ORTDM. For example, Respondent 6 said, "… *This municipality is rural, and if you go out there, you*

will find there are several stand-alone schemes where you will find the source is a borehole…. we will do away with the stand-alone schemes, all those communities will be served from the regional scheme….".

However, Respondents 3, 4, 5 and 7 were not specific on applied strategies, except suggesting that the municipality should install smart meters and standardise its infrastructure technology choices to improve its response time to water interruptions, infrastructure maintenance and enhance water supply reliability. For example, Respondent 7 said, "…*The challenge that we have in OR Tambo is that we do not have a uniform design standard that every project should follow for us to ease the operations and maintenance…*", suggesting shortcomings in how ORTDM has performed in ensuring water supply reliability, including ensuring easily accessible spare parts.

Information found in the ORTDM IDP (2020/21) suggests that the municipality is considering venturing into alternative technologies to enhance water supply reliability:

> "*A differentiated approach needs to be explored on the various services infrastructure technologies that will consider the topography and the vastness of the ORTDM. The current conventional infrastructure delivery is expensive, requiring high levels of capacity for the municipality to operate and maintain over time*" (ORTDM IDP, 2020/21).

The findings above revealed strategies and practices used in ORTDM to ensure the choice of infrastructure technology improves water supply reliability. These include shifting from diesel-operated engines to electric engines-operated regional water supply schemes; the shift not only saves operating costs and ensures the reliability of the water supply but is also suitable for reducing the ORTDM carbon footprint. The findings also revealed that ORTDM is considering exploring a differentiated approach to water infrastructure technology to improve water supply reliability. The findings further suggest that the variance in infrastructure technology used in ORTDM is prohibitive to improved water supply reliability.

iv) Ensure the choice of infrastructure technology that promotes economic efficiency

Respondent 3, Respondent 4 and Respondent 6 considered the ORTDM plans to install smart meters, embark on water conservation and demand management initiatives, and the strategy to change from diesel-operated stand-alone schemes to electric-operated regional schemes as appropriate technological shifts and strategies by ORTDM to promote economic efficiency. For example, Respondents 3 and 4 said, "… *I know in the town areas, there was a talk now in terms of the policy to look in terms of the installation of smart meters, to enable operators to sit in the office and read the meters remotely…*" and "… *We are also looking at water*

conservation and demand management initiatives that we are embarking on now ...", respectively. Respondents 5 and Respondent 7 were not specific on applied strategies, except suggesting that the municipality should build the capacity of locally based suppliers to produce required infrastructure technology locally to reduce procurement costs and delays. For example, Respondent 7 said, "…*If we can train and develop local SMMEs to supply the necessary technology that will be common and easy to use, that will be an advantage and an opportunity to OR Tambo ...*".

Respondent 2 stated that *"...the budget is always limited..."* suggesting ORTDM has challenges that affect their overall performance of the economic efficiency objectives in water services.

Information found in the ORTDM WSDP (2020/21) also confirmed the shortage of skills and limited budget allocation highlighted by respondents:

> "*There is a huge shortage of resources, which include budget, skilled staff and equipment*".

The findings above revealed strategies and practices used in ORTDM to ensure the choice of infrastructure technology that promotes economic efficiency. These strategies include incorporating life cycle costing and resource consumption reduction practices, such as installing smart meters for water leak detection, shifting to electric-operated water pumps, adopting water conservation and demand initiatives and focusing on intergenerational equity initiatives by developing local suppliers to supply ORTDM with infrastructure technology. However, findings from interviews and key municipal documents also reveal that the budget constraints and shortage of personnel and equipment in the operations and maintenance unit compromise these efforts.

4.2.4.1 DISCUSSION ON ENGINEERING SUSTAINABILITY INTEGRATION

This study's findings revealed that the ORTDM implements strategies and practices that include incorporating in infrastructure project plans and designs, life cycle costing and resource consumption reduction practices, such as installing smart meters for water leak detection, shifting to electric-operated water pumps, adopting water conservation and demand initiatives and focusing on intergenerational equity initiatives by developing local suppliers to supply ORTDM with infrastructure technology. The ORTDM's commitment to conducting comprehensive feasibility studies emerged as a recurrent theme, demonstrating a proactive approach to assessing the appropriate technology to enhance engineering sustainability. ORTDM's strict adherence to design guidelines and standards, collaboration with reputable

design engineers and suppliers, in-house project managers, and rigorous material testing procedures collectively contribute to delivering durable water supply distribution systems. The material testing procedures integrated into ORTDM are quality assurance measures to ensure infrastructure reliability, functionality, and durability. However, the findings also suggest that budget constraints, unavailability of operations and maintenance plan, use of different infrastructure technologies, delays in procurement, poor road infrastructure and shortage of personnel in the operations and maintenance unit are currently prohibitive to integrating engineering sustainability strategies in ORTDM.

The case study conducted by Buluma, Keror and Bonuke (2013) on the municipal council of Eldoret highlighted challenges similar to those encountered by ORTDM. Their findings revealed that insufficiently skilled personnel and inadequate technology negatively impacted the implementation of council strategic plans. Similarly, the research by Moloto, Mkhomazi and Worku (2020) confirmed that the rural setting of a municipality presents a barrier to service delivery, thereby hindering the achievement of strategic objectives, a conclusion consistent with the challenges observed in engineering sustainability integration within ORTDM.

Moreover, the discovery that budget constraints and a lack of infrastructure operations and maintenance budgets impede the implementation of engineering sustainability integration strategies in ORTDM aligns with the findings of Bikam and Chakwizira (2021). Bikam and Chakwizira's (2021) study highlighted how the effective execution of municipal strategies, such as proactive infrastructure maintenance, is adversely affected by the inadequate allocation of financial resources.

4.2.5 PROJECT MANAGEMENT SUSTAINABILITY INTEGRATION

The ORTDM IDP (2020/2021) and ORTDM WSDP (2020/2021) documents have been examined to identify information about how ORTDM integrates project management sustainability. Further, to complement the qualitative data from the ORTDM IDP (2020/21) document, participants were asked questions to gain their perspective on practices, policies, and strategies employed by ORTDM for integrating project management sustainability.

Specifically, the seven participants were asked to express their opinions on how the municipality's current water services planning and implementation strategies and processes contribute to (i) Ensuring water infrastructure delivery mechanisms do not promote the depletion of financial resources, (ii) Ensuring water infrastructure delivery mechanisms are not harmful to the natural environment, and (iii) Ensuring that processes leading to the delivery of water supply distribution systems are conducted in a transparent, fair, and ethical way.

i) Ensure water infrastructure delivery mechanisms do not promote the depletion of financial resources

The majority of the respondents viewed the involvement of ORTDM Project Managers, supported by appointed technical engineering consultants, in developing project designs and monitoring of project scope, time, cost and quality during implementation, as well as conducting project feasibility studies as a strategy used by ORTDM to ensure infrastructure delivery mechanisms do not promote depletion of financial resources. For example, Respondent 3, Respondent 6, and Respondent 7 said, "…*there are project managers who are employed by the district municipality who are looking at the scope, the cost, and the time of how the projects are implemented ...*", "*...We also manage the financial resources, and time as well, because ORTDM project managers are technical, they work together with a technical consultant….*" and "…*OR Tambo, during the project planning stage, conducts a feasibility study to ensure that every project that is to be implemented is financially viable*…", respectively.

Information found in the ORTDM IDP (2020/21) mentioned developmental objectives stating what the ORTDM intends to do over the five-year cycle to deal with infrastructure project delivery:

> "*To ensure the provision of effective, efficient and sustainable water services (including water conservation and demand management) either by providing water services themselves or by selecting, procuring and contracting with external Water Service Providers*" (ORTDM IDP, 2020/2021).

Further, information found in the ORTDM IDP stated:

> "*The MFMA further requires the Integrated Development Plan (IDP) to be aligned to the municipal budget and to be monitored for the performance of the budget against the IDP via the SDBIP*".

The findings above reveal that the ORTDM uses the Municipal Financial Management Act, 2003 (Act 56 of 2003) as a guiding legislative tool to ensure that infrastructure development mechanisms do not deplete municipal financial resources. However, the procedure to ensure the act's requirements are achieved and guide infrastructure delivery programmes to sustainable outcomes has not been explicitly revealed. Further findings also indicate that ORTDM employs internal project managers to oversee project planning and implementation, appoint technical consultants to complement the internal capacity plan, and design, monitor and prepare feasibility studies mechanisms to ensure water infrastructure delivery is done sustainably. These findings suggest that the ORTDM lacks internal expertise and experience

to execute strategies related to providing water infrastructure delivery mechanisms that do not promote the depletion of financial resources. Hence, they use external consultants.

ii) Ensure water infrastructure delivery mechanisms are not harmful to the natural environment

Most respondents mentioned adhering to EIA requirements, conducting environmental impact audits, engaging engineering consultants to design infrastructure technology with minimal adverse environmental impacts, and ensuring projects adhere to quality standards. For example, Respondent 2, Respondent 6, and Respondent 7 said, "…*In each project, we make sure that we do the audits in terms of environmental issues, through the Environmental Department or the Environmental Consultants that will regularly visit the project* ...", "*...We manage several things, like the environmental impact, of the project*…." and "…*We also do environmental impact assessments to ensure that projects that are going to be implemented are not harmful or to the detriment of the environment and also during implementation the environmental consultant monitors the implementation of a project to ensure that guidelines are being followed*…", respectively. Shortage of internal personnel to monitor environmental issues was raised by Respondent 4 and Respondent 7, who said, "…. *We do not have capacity internally at this time…I think the only capacity we have is the ISD, which is the institutional social development, used for community participation and social related matters – but for environmental, we are actually using the consultants to undertake those processes*…." and "…. *We do not have inside skills to monitor*…", respectively.

Information found in the ORTDM IDP (2020/21) has also emphasised the use of the Environmental Management Act (Act No. 107 of 1998) as a guiding legislative mechanism to ensure infrastructure development programmes are not harmful to natural resources and the environment, including compliance monitoring procedures:

> "*Environmental governance refers to the decision-making processes in managing and controlling the environment and natural resources. The National Environmental Management Act (Act No. 107 of 1998) promotes the application of appropriate environmental management tools to ensure the integrated environmental management of activities and sustainable development*" *(ORTDM IDP, 2020/21: 84)*.
>
> "*ORTDM EIA monitoring team play an important role in the framework for the monitoring of conditions set in the ROD (Records of Decision) and Environmental Management Plan (EMP) during project implementation and operation*" *(ORTDM IDP, 2020/21: 87)*.

Findings from the interviews and the key municipal documents revealed that ORTDM uses structured legislative mechanisms like the Environmental Impact Assessment (EIA) processes and conducts environmental impact audits to ensure water infrastructure delivery mechanisms are not harmful to the natural environment. The highlighted challenge with internal capacity resulting from the shortage of Environmental Management Officers suggests that the successful implementation of ORTDM strategies might be compromised.

iii) Ensure that processes leading to the delivery of water supply distribution systems are conducted in a transparent, fair, and ethical way

Most respondents mentioned public participation platforms such as IDP development processes and the project steering committees as ways that ORTDM ensures that processes leading to the delivery of water supply distribution systems are conducted transparently, fairly, and ethically. For example, Respondent 7 said, "…. *OR Tambo during IDP road shows, allows the public to participate….and during the time of project implementation, ISD Consultants are appointed to ensure that they establish PSCs, where the PSC forms part of the discussions on project matters during project implementation*".

Further information found in the ORTDM IDP (2020/21) stated:

> "*The IDP 2020/21 drafting process happened through stakeholders' and community's engagement at various platforms such as strategic planning, IDP representative forums, and roadshows. Inputs from these sessions have shaped the municipal focus and its agenda over the financial year*" ORTDM IDP (2020/21).

Findings from both the interviews and the key municipal documents revealed that ORTDM uses structured legislative mechanisms like the Integrated Development Plan (IDP) drafting process, as a mechanism that encourages public participation to ensure transparency and fairness, wherein community inputs and their needs presented shape the developmental direction of ORTDM. However, the effectiveness of this process in serving as a platform to encourage fairness and transparency in service delivery is not elaborated on. The lack of elaborative detail on the efficacy and success of this practice in achieving ORTDM strategies related to encouraging fairness and transparency in service delivery suggests that the successful implementation of ORTDM strategies might be compromised.

4.2.5.1 DISCUSSION ON PROJECT MANAGEMENT SUSTAINABILITY INTEGRATION

This study's findings revealed legislative prescripts highlighted in the ORTDM IDP (2020/21) that the municipality uses to guide achieving project management sustainability integration.

The shared perspectives emphasise key objectives, including safeguarding financial resources, minimising harm to the natural environment, and ensuring transparent, fair, and ethical processes in the delivery of water supply distribution systems. However, the ORTDM project manager's lack of experience in working with complex projects and a lack of adequately skilled internal personnel could imply that the municipality cannot fully implement strategies to foster project management sustainability integration.

The studies conducted by Tsibani (2007) and Mokgethi and van der Waldt (2020) share similarities with the findings identified in ORTDM regarding the challenges that impede the successful implementation of its project management strategies. Tsibani's research revealed that inadequate capacity within Water Services Authorities (WSAs) is a significant factor contributing to the failure to fulfil their legislative mandates, which includes the delivery of infrastructure projects (Tsibani, 2007: 33). Mokgethi and van der Waldt (2020: 136) identified inadequate project management capacity as a challenge facing the municipal Project Management Units (PMUs) in undertaking project design and implementation.

4.2.6 RESILIENCE THINKING AND RESILIENCE BUILDING PRACTICES IN ORTDM

The ORTDM IDP (2020/21) and ORTDM WSDP (2020/21) documents were analysed to establish documented practices, policies, and strategies employed by ORTDM to enhance its water infrastructure and institutional resilience. To complement the qualitative data information taken from the ORTDM IDP (2020/21) and ORTDM WSDP (2020/21) documents, participants interviewed were asked questions to gain their perspective on resilience thinking and resilience building in ORTDM.

Five of the seven respondents perceived ORTDM as lacking resilience capabilities to deliver resilient water supply distribution systems. For example, Respondent 2 and Respondent 7 said, "*…the truth is, I doubt that the municipality is in the right space to say they can respond quickly when the infrastructure has been disturbed or otherwise ….*" and "*…as OR Tambo, we are not doing well at all regarding resilience…*", respectively. Slow response time, reactive operations, maintenance and budget limitation were among the factors raised by respondents to support their perception. For example, Respondent 3, Respondent 6 and Respondent 7 said, "*…the ability that the municipality is having to recover from natural floods and man-made vandalism…I would say it is pretty low because they do not have funding on their own to do that….*", "*…. taps are there, but then when you open those taps there is no water that is coming out of those taps - so our communities are really not happy - so if the municipality can invest more money on the operation and maintenance to make sure that the infrastructure that is*

invested by the municipality is in an operational condition. …." and "*…our response time is prolonged - because of budget constraints - our budget is minimal in terms of Operation & maintenance – limited supply or availability of materials in our stores to respond - non-uniformity of standards in our designs implemented technologies and - materials also delays our response time - This also makes the municipality very slow in restoring the services to normal*", respectively.

Only Respondent 4 said, "*…we managed to respond quickly through the use of our term contracts……we managed to restore the disturbance we had in our water supply schemes.…*", suggesting that the ability ORTDM lacks internally they supplement by using external service providers through "term contracts" to undertake the works on their behalf.

The following information represents developmental strategies found in the ORTDM WSDP (2020/21) and ORTDM IDP (2020/21), indicating ORTDM's objectives, strategies, practices and plans to ensure its water infrastructure systems and institutional resilience are enhanced:

> "*Ensure adequate operation and monitoring of infrastructure components and maintain existing infrastructure to provide adequate services*" (ORTDM WSDP, 2020/21: 146).
>
> "*Employ skilled staff to perform Water Services Authority functions*" (ORTDM WSDP, 2020/21: 149).
>
> "*Building stable institution to deliver services. The district will forge ahead with its strategy to recruit qualified, competent, and skilled staff to execute its agenda. This will further be complemented by skilling the young people so they are ready to assist in this broader agenda*" (ORTDM IDP, 2020/2021).

However, despite the highlighted developmental strategies, information found in the ORTDM WSDP (2020/21) reflected:

> "*The lack of an Operations and Maintenance Plan in ORTDM needs to be addressed*" (ORTDM WSDP, 2020/21: 87).

4.2.6.1 DISCUSSION ON RESILIENCE THINKING AND RESILIENCE PRACTICES IN ORTDM

This study's findings revealed that the ORTDM implements strategies and practices to build the resilience of its infrastructure and organisational resilience. The majority of the respondents perceived ORTDM as lacking resilience capabilities and expressed challenges with achieving resilience-building strategies and practices in ORTDM. Findings from the analysed municipal

documents confirmed the lack of resilience capabilities in ORTDM perception raised by respondents. The findings highlighted that limited operations and maintenance budgets, lack of operation and maintenance plans, vandalism, and the shortage of skilled personnel to manage, operate, and maintain infrastructure are significant obstacles to ORTDM's ability to achieve resilient organisation and resilient water supply distribution systems. The lack of resilience capabilities could imply that the municipality cannot fully implement strategies to foster resilience thinking and resilience-building practices.

Financial resources and preventative strategies, such as proactive infrastructure maintenance and availability of expert personnel, are identified as lacking within ORTDM. Duchek (2020) also recognises these elements as drivers of organisational resilience capabilities. According to Duchek (2020: 238), organisational resilience capabilities encompass "anticipation abilities, particularly in preventative measures against disruptions". Consequently, the absence of these capabilities within ORTDM hampers the municipality's ability to cultivate resilience. This aligns with the findings of Bikam and Chakwizira (2021), who similarly noted that low revenue in rural municipalities prevents efficient implementation of preventative measures, such as operations and maintenance of existing infrastructure, thereby compromising the resilience of infrastructure assets.

To address the challenge of poor resilience capabilities, ORTDM must prioritise budget allocation and appoint skilled personnel for water infrastructure operations and maintenance. This approach is crucial for ensuring the sustained and reliable provision of water supply to communities (Rodina, 2019: 2).

4.3 CHALLENGES AND OPPORTUNITIES RELATED TO SUSTAINABILITY INTEGRATION IN ORTDM

Literature in Chapter 2 (Section 2.4) of this study has identified several challenges and opportunities to integrate sustainability principles, but these were not all specific to a municipality. However, this section of the study seeks to present and discuss identified challenges and opportunities for sustainability integration in ORTDM. ORTDM IDP (2020/21) and ORTDM WSDP (2020/21) were analysed to identify documented challenges and opportunities specific to the ORTDM context. Further, ORTDM employees were also interviewed, and information about challenges and opportunities regarding sustainability integration in ORTDM was provided. The challenges and opportunities that emerged from the document analysis and interviews are henceforth presented and discussed.

4.3.1 CHALLENGES RELATED TO SUSTAINABILITY INTEGRATION IN ORTDM

The ORTDM IDP (2020/21) and ORTDM WSDP (2020/21) were analysed to identify challenges related to sustainability integration in ORTDM. Further, to gain an in-depth understanding and allow for comparison of the information, seven participants from ORTDM were interviewed to gain their perspective on sustainability integration challenges in ORTDM. Twenty-six (26) combined initial challenges emerged from the interviews together with those identified from the key municipal documents. The identified challenges were then categorised, and five key themes were developed to be presented as findings and discussed. The key themes that emerged include (i) Resource Challenges, (ii) Social Challenges, (iii) Technical Challenges, (iv) Governance Challenges, and (v) Environmental Challenges. The themes are presented with no particular importance, but it is important to note that "Social and Technical" related challenges emerged more frequently from both interviews and documents. This could imply that the ORTDM is not doing well in the sustainability integration of social, engineering, and project management aspects. For a consolidated list of challenges identified, categorised into the five key themes, and linked to their source reference (see Appendix G).

The following are the key themes that emerged and are presented below as this study's findings:

i) Resource Challenges

There were five (5) resource-related challenges identified from municipal documents and mentioned by respondents, which include financial resources limitations, natural resources limitations, limited material suppliers within the ORTDM jurisdiction, access to technology limitations, under-capacitated internal personnel and skills shortage amongst municipal officials responsible for water services. All seven respondents mentioned financial resources limitation; Respondent 2 and Respondent 7, in particular, said, "…*the budget is always limited..."* and "…*the challenges that we are encountering is the budget limitation and also the lack of skills inside, as we do not have inside skills to monitor…*", respectively. The challenge of under-capacitated internal personnel was also mentioned by at least six respondents, including Respondents 1,2,4,5,6 and 7, making it the second-ranked challenge under resource challenges. For example, Respondent 6 said, "… *because we do not have internal expertise, we appoint a service provider*….".

Information found in the ORTDM WSDP (2020/21) and ORTDM IDP (2020/21) confirming some of the challenges revealed by respondents reflected, "*There is a huge shortage of resources, which include budget, skilled staff and equipment*" and "…*The growing needs of*

the increasing population in ORTDM have also resulted in a growing demand for development...", respectively, among the resources challenges documented.

ii) Social Challenges

Seven (7) social-related challenges were identified from municipal documents and mentioned by respondents, including high population growth, community protests, high poverty and illiteracy levels among communities, high unemployment and inequality rates, and significant infrastructure backlogs. Vandalism and theft, together with a lack of community satisfaction and buy-in, were also identified in documents and mentioned as challenges by Respondents 2, 3, 4, 5, 6 and 7. For example, Respondents 5, 6, and 7 said, "… *the problem we have is that our projects are long-term projects; the community is not satisfied with that because we are not giving them what they expect when our projects take long to deliver what is expected*…", "… *there is also an issue of vandalism and theft that is taking place in our infrastructure...*" and "…. *taps are there but the when you open those taps there is no water that is coming out of those taps - so our communities are really not happy…*", respectively.

Information found in the ORTDM WSDP (2020/21) and ORTDM IDP (2020/21) confirmed some of the challenges revealed by respondents, reflected, "*High Level of Vandalism and theft*" and "*...The extent of the water supply backlog within the O R Tambo District Municipality is 28,2 % with the majority of the households that still have no access to any water supply infrastructure...*", respectively, among the social challenges documented.

Further information found in the ORTDM IDP (2020/21) highlights some of the social-related challenges experienced by ORTDM and its commitment to addressing them:

> "*Together with the stakeholders of the region, such as civil society, labour, business, and political parties, we identified and recognised the challenges that undermine the democracy breakthrough, which are unemployment, poverty, and inequality. Over the year, we commit to striving to ensure that our Vision of "A prosperous, vibrant, innovative and people-centred district" is realised by the people of the district at large*" (ORTDM IDP, 2020/2021).

iii) Technical Challenges

There were six (6) technical-related challenges identified from municipal documents and mentioned by respondents, which include lack of project management and engineering standards in ORTDM, Lack of Operations and Maintenance Plans, Poor maintenance of existing infrastructure, Old and non-functional water schemes, lack of standardised infrastructure design guidelines, project delivery delays due lack of expertise by appointed service providers to undertake various projects. Respondents 4, 5, 6, and 7 all commented on

the lack of standardised design guidelines. For example, Respondent 6 said, "…*we do not have our own standards as the municipality*...". Respondents 3, 4, 6, and 7 all mentioned project delivery delays. For example, Respondent 4 said, "…*We have contractors that tend not to perform during the implementation, and then it prolongs the project delivery*...".

Information found in the ORTDM WSDP (2020/21) and ORTDM IDP (2020/21) confirming some of the challenges revealed by respondents, reflected "*Old infrastructure and non-functional water schemes*" and "*Poor maintenance of existing infrastructure*", respectively, among the technical challenges documented.

iv) Governance Challenges

There were five (5) governance-related challenges identified by respondents, which include weak organisational resilience capabilities, "inability to respond to disruptions", lack of sustainable infrastructure development policies, political interference, delays in obtaining water use licenses, delays in project approvals for funding and lack of internal staff training programmes. Respondents 2, 3, 4, 5, 6, and 7 all highlighted the inability to respond quickly to water supply interruptions and disruptions and the lack of internal staff training programmes as leading governance challenges in ORTDM. For example, Respondents 1, 2, 3, 4 and 7 said, "*...there a lot of politics within the service that we are offering…*", "*..the honest truth is, I doubt that the municipality is in the right space to say they can respond quickly when the infrastructure has been disturbed or otherwise*…", "*...in actual fact we are not able to recover quickly from all the disturbances be it floods or vandalism* …", "…*in terms of resilience, you may find that it is not there*..." and "…*as OR Tambo we are not doing well at all in terms of resilience is concerned*…." respectively, suggesting ORTDM as an organisation has weak resilience capacity.

v) Environmental Challenges

Three (3) environmental-related challenges were identified from municipal documents and mentioned by respondents, including environmental pollution, lack of holistic approach to Water Conservation and Demand Management and land grabs leading to biodiversity loss**.** On the challenge of land grabs affecting environmental sustainability, Respondent 3 said, "…*the fact that although some areas are left not to be disturbed environmentally, the issue of land grabs is destroying everything*...".

Information found in the ORTDM WSDP (2020/21) and ORTDM IDP (2020/21) confirming some of the challenges revealed by respondents reflected, "*Pollution in the environment*" and "…*The absence of proper land use management systems also meant that there were parallel and complex land administration processes. This situation has resulted in uncontrolled urban*

expansion, loss of arable land, destruction of sensitive environment, overburdening of infrastructure and services, etc…", among the documented environmental challenges.

4.3.1.1 DISCUSSION ON THE CHALLENGES RELATED TO SUSTAINABILITY INTEGRATION IN ORTDM

On sustainability integration challenges in ORTDM, the study found that while the ORTDM has made efforts to incorporate sustainability principles into its water supply distribution programmes, implementing these principles is currently restricted by the above-identified challenges. Addressing and eliminating these barriers is essential to achieving long-term integration of social, economic, environmental, engineering, and project management aspects into development programmes.

The research studies conducted by Aiyetan and Das (2021); Rincón, Santos, Volker and Rouwenhorst (2021); Wälitalo, Callghan, Robert and Broman (2023); and Batista, Goyannes, Goncalves, Brito, Leal and Rocha (2021) in municipalities worldwide on barriers to the successful implementation of sustainability transitioning strategies, all revealed challenges similar to those identified in ORTDM. Rincón et al. (2021: 4) found a lack of resources, institutional constraints, and capacity challenges in their study of Swedish and Australian municipalities. Wälitalo et al. (2023: 8) identified economic, competence, and organisational challenges as common factors among the municipalities they studied. Lastly, Batista et al. (2021: 22) revealed that poor public policies, limited funding sources, and financially unfeasible projects pose significant obstacles to integrating sustainability into municipal development programs.

4.3.2 OPPORTUNITIES RELATED TO SUSTAINABILITY INTEGRATION IN ORTDM

Respondents identified several opportunities ORTDM could leverage to achieve sustainability integration initiatives. For example, Respondent 3, Respondent 4, Respondent 6 and Respondent 7 said, "…. *there are businesses that have been put around the Peri-Urban, there are block yards, there are B & Bs, there are student accommodations that are in these Peri-Urban areas if those people can be billed because they are operating businesses in there. It will improve in terms of the financial resources the municipality is having…*", "*…We have more staff than the other municipalities....*", "*….so if the municipality can invest more money on the operation and maintenance to make sure that the infrastructure that is invested by the municipality is in an operational condition. ….*" and "*…If we can train and develop local SMMEs to supply the necessary technology that will be common and easy to use that will be an advantage and an opportunity to OR Tambo …*", respectively.

Information found in the municipal WSDP highlighting the opportunities and how the ORTDM plans to leverage them to achieve its sustainable developmental agenda are presented as follows:

> "*Due to the relatively young population, a need exists in ORTDM to develop skills. Developing skills is vital to reducing the area's unemployment and can benefit the local economy. It is important to focus on socio-economic upliftment to alleviate poverty through job creation*" (ORTDM WSDP, 2020/2021).

> "*In order to meet the demand, ORTDM also needs to collaborate with the private sector and local non-profit organisations to provide needed skills at all levels*" (ORTDM WSDP, 2020/2021).

Further, information found in the ORTDM WSDP emphasised the need for the municipality to make the most of available opportunities to strengthen its sustainability:

> "*It is critical that infrastructure development opportunities are promoted to generate job creation. Opportunities exist in the development, operation maintenance, and management of water and sanitation infrastructure, and indirect opportunities are created through associated water supplies in the transport, agriculture, and manufacturing sectors*" (ORTDM WSDP, 2020/2021).

4.3.2.1 DISCUSSION ON OPPORTUNITIES RELATED TO SUSTAINABILITY INTEGRATION IN ORTDM

This study's findings suggest that the ORTDM has various opportunities to capitalise on. A notable aspect is the district's significant youth population, offering the municipality an opportunity to address social challenges like unemployment through skills development programs and involving youth in infrastructure projects. Additionally, there is an opportunity to train a substantial number of internal staff for in-house infrastructure operations and maintenance. Investing in local small, medium, and micro enterprises (SMMEs) to offer sustainable infrastructure technology, collaborating with existing peri-urban businesses to boost revenue streams, and institutionalising a water conservation and demand management program are further avenues to preserve water sources, ensure water security, and reduce non-revenue water. Access to the Wild Coast provides another opportunity for ORTDM to invest in seawater desalination technology to augment its water sources for the coastal towns (Swartz, Du Plessis, Burger and Offringa, 2009).

4.4 CONCLUSION

This study reveals that although the ORTDM has made efforts to integrate sustainability principles into its water supply distribution systems development programmes, several challenges are limiting achieving the desired outcomes. These challenges include financial and natural resources constraints, limitations in organisational capacity and competence, inadequate planning and maintenance of existing infrastructure, limited access to competence and capability to foster sustainable infrastructure design and construction, a high incidence of vandalism and theft of infrastructure assets, significant socio-economic challenges within ORTDM jurisdiction, biodiversity loss exacerbated by land grabs and environmental pollution, and a fragmented approach to water conservation and demand management. Therefore, addressing and eliminating these barriers is essential to achieving long-term integration of social, economic, environmental, engineering, and project management sustainability aspects into ORTDM development programmes (Zhong and Wu, 2015).

CHAPTER 5: RECOMMENDATIONS AND CONCLUSION

5.1 INTRODUCTION

Chapter 5 focuses on the final objective, which is to formulate recommendations on how ORTDM can improve the sustainability of its water supply services in an effort to improve their resilience. The chapter begins by summarising the key findings and, subsequently, based on the findings, proposes recommendations for implementation by ORTDM. Additionally, the chapter addresses the study's limitations and presents suggestions for future research.

5.2 RESEARCH FINDINGS SUMMARY

As a reminder, the main aim of this research was to evaluate the integration of sustainability principles to enhance the resilience of water supply distribution systems in the ORTDM. Its specific objectives were to assess the integration of sustainability principles in municipal water supply development programmes, to investigate the challenges and opportunities related to this integration as perceived by the municipality, and to propose recommendations to improve the sustainability and resilience of water supply services.

The study identified several challenges that impede the integration of sustainability principles in ORTDM. These challenges fall into categories such as resource constraints, as well as social, technical, governance, and environmental challenges. They align with those previously identified by Pasquini et al. (2015), Calabrese et al. (2019), Rincón et al. (2021), Wälitalo et al. (2023), and Batista et al. (2021). Their studies on municipalities worldwide investigated barriers to successfully implementing sustainability transitioning strategies, and all revealed challenges similar to those identified in ORTDM.

Financial and natural resource constraints are the most significant resource-related challenges hindering the successful integration of sustainability principles in ORTDM. Financial limitations result from budget constraints and restrictions on funding sustainable infrastructure development projects. Meanwhile, the shortage of surface water sources within the district municipality contributes to natural resource constraints.

Social challenges affecting sustainability integration in ORTDM include a high incidence of vandalism and theft of infrastructure assets and significant socio-economic challenges within the municipality's jurisdiction. Poverty often correlates with increased criminal activity, such as vandalism, leading to the theft of infrastructure components for sale as scrap metal (Moloto, Mkhomazi and Worku, 2020). This creates financial burdens for the municipality, which struggles to replace stolen parts due to budget constraints. Moreover, poverty and

unemployment rates impact the municipality's ability to collect rates for services rendered, further straining its resources.

Technical challenges primarily revolve around project management and engineering capabilities. Limited access to competent infrastructure design engineers and project managers poses a significant obstacle to fostering sustainable infrastructure design and construction. Additionally, the municipality's internal capability and competence to plan and maintain existing infrastructure contribute to service delivery failures.

Organisational challenges also hinder the effective integration of sustainability principles in ORTDM, notably related to capacity and competence limitations. These issues include a shortage of skilled personnel within the municipality with expertise in sustainable service delivery initiatives. Insufficient training and development initiatives further exacerbate this challenge, leading to heavy reliance on costly external service providers for expert advice.

Environmental challenges hindering sustainability integration initiatives in ORTDM are linked to biodiversity loss exacerbated by land grabs and environmental pollution. A fragmented water conservation and demand management approach also contributes to high non-revenue water and water losses.

5.3 RECOMMENDATIONS FOR IMPLEMENTATION

In view of the research findings, this study recommends that ORTDM, in its efforts to improve the overall sustainability and resilience of water services, should prioritise implementing management approaches to overcome the challenges impeding sustainability integration. The recommended management approaches are noted as follows:

5.3.1 MANAGING RESOURCE CHALLENGES

To enhance its financial resources, it is recommended that the ORTDM actively explores collaborative relationships with private entities to distribute the financial responsibility of delivering water infrastructure projects (AbouAssi, Bowman, Johnston, Bauer and Tran, 2021). Furthermore, AbouAssi et al. (2021: 4) recommend that local governments proactively pursue infrastructure grants and subsidies from governmental agencies, non-profit organisations, and international bodies to alleviate financial constraints and eradicate infrastructure backlogs. This recommendation provides another avenue for ORTDM to consider in their quest to deliver sustainable services to communities.

The municipality is further advised to explore alternative water sources for coastal towns, focusing on enhancing water supply reliability (Swartz et al., 2009: 641). Options such as seawater desalination should be considered to diversify water sources and mitigate the impact

of water scarcity in these regions. This strategic exploration of alternatives contributes to developing a more robust and adaptable water supply system (Swartz et al., 2009). The Kenton-On-Sea initiative, a town located in Ndlambe Local Municipality (South Africa), is a model example of how seawater desalination could benefit ORTDM in augmenting its water sources (Smakhtin, Ashton, Batchelor, Meyer, Murray, Barta, Bauer, Naidoo, Olivier and Terblanche, 2001). It is therefore recommended that the ORTDM considers the use of seawater desalination technology to provide alternative water sources for towns like Port St Johns, Lusikisiki and Coffee Bay, which are along the coastal areas of the ORTDM as part of green building initiatives (Vithi-Masiza, Botha and Mbanga, 2023).

5.3.2 MANAGING SOCIAL CHALLENGES

It is recommended that the municipality establish community-based infrastructure monitoring structures to identify and prevent infrastructure vandalism and theft. This is a model similar to the one implemented by Mutale Local Municipality in Limpopo, South Africa, wherein the municipality engaged the Maheni Community to secure their water sources and infrastructure, a practice that saw a reduction in vandalism and improved water source security (Rankoana, 2020). ORTDM, through this model, could effectively communicate project-related issues to all stakeholders, thereby improving social cohesion and reducing incidents of vandalism and theft (Adeyeye, Gibberd and Chakwizira, 2020).

Further, Moloto, Mkhomazi and Worku (2020), supporting Mokgethi and van der Waldt's (2020) suggestions, propose the adoption of a "participatory project delivery methodology" by municipalities to enhance community ownership of projects. Therefore, it is recommended that ORTDM adopt a similar strategy, actively involving local communities in planning and decision-making processes to ensure social acceptance of water services management and development initiatives. Through this participatory approach, ORTDM can enhance community well-being by encouraging local economic development initiatives and guarantee equitable access to water services (Lebek, Twomey and Krueger, 2021).

5.3.3 MANAGING TECHNICAL CHALLENGES

It is recommended that the ORTDM formulate and implement standardised project management and engineering design guidelines linked to sustainability-related practices (Joslin and Müller, 2015). These should cover the ORTDM sustainability objectives, targets and related assessment criteria for all involved in infrastructure project development to understand, adhere to and adopt (Rincón et al., 2021). When integrated within the ORTDM, these guidelines will ensure uniformity and improvement in the delivery of water infrastructure projects (Aiyetan and Das, 2021).

Furthermore, Aiyetan and Das (2021) recommend establishing a mentorship program to foster collaborative relationships between under-capacitated municipalities and established municipalities or private engineering entities possessing in-house sustainable infrastructure design capacity and experienced professionals. Therefore, the ORTDM should establish a mentorship program per Aiyetan and Das's (2021) recommendation. The aim is to mentor the emerging pool of project managers and engineers within ORTDM. This collaborative effort is meant to facilitate knowledge transfer and stimulate innovation, particularly in the domains of sustainable development, project management, and engineering.

Lastly, a recommendation is made for the municipality to invest in training and development programs to improve the capacity of personnel in the Project Management Unit (PMU) and develop a project management methodology for the ORTDM. Mokgethi and van der Waldt (2020) proposed a similar strategy for Ramotshere Moiloa Local Municipality, which is facing capacity challenges identical to ORTDM's. This strategic initiative aims to improve its personnel understanding of project management principles and engineering standards, thereby leading to improved project outcomes (Mokgethi and van der Waldt, 2020). The training and development initiative should encompass technical training for engineers, operators, and infrastructure maintenance staff, ensuring water infrastructure's proficient operation and maintenance (Bikam and Chakwizira, 2021).

5.3.4 MANAGING GOVERNANCE CHALLENGES

It is recommended for ORTDM to capacitate its organisational structure and allocate resources aimed at facilitating the effective implementation of municipal strategies. This involves prioritising filling crucial leadership positions with "qualified, competent, passionate and ethical individuals" (Reddy, 2016: 8). Implementing this recommendation will ensure the effective delivery of services.

Nkosi (2015) emphasises the importance of the ongoing development of municipal employees and formulating policies aligned with municipal objectives to ensure the efficient execution of strategies. These policies should adhere to sustainability principles, prioritise long-term planning, and actively contribute to ORTDM's resilience-building initiatives. Consequently, it is recommended that ORTDM formulate and adopt comprehensive policies that prioritise the development of sustainable infrastructure.

Furthermore, the ORTDM should initiate employee training and development programs tailored to enhance competencies in implementing sustainability-driven practices in accordance with organisational policies and developmental strategies. Implementing this

recommendation will reduce ORTDM's reliance on external engineering consultants (Aiyetan and Das, 2021).

5.3.5 MANAGING ENVIRONMENTAL CHALLENGES

The research conducted by Sigwela, Elbakidze, Powell and Angelstam (2017) in the Tsitsa River catchment in the Transkei region (South Africa) emphasised the significance of Ecological Infrastructure, such as rivers, grasslands, and forests, in providing various Ecological Services. These services, including water provision, cultural relevance, and grazing land for livestock, play crucial roles in the livelihoods of indigenous communities in the Transkei (Sigwela et al., 2017). Their study recommended implementing land rehabilitation programs alongside stewardship and management practices to preserve the composition, structure, and function of ecosystems of the Tsitsa River catchment area. Thus, this study recommends that ORTDM implement land rehabilitation programmes alongside water conservation and demand management practices to preserve and protect ecological infrastructure. To ensure the initiative's effectiveness, an all-stakeholder inclusive approach has to be adopted for stewardship, monitoring and acceptance (Sigwela et al., 2017).

As part of effective Water Conservation and Demand Management (WCDM) strategies, it is recommended that ORTDM integrate intelligent technologies such as smart meters, sensors, and control systems into water distribution systems to detect and mitigate water losses from leaks and inefficiencies proactively. The recommendation is aligned with a recommendation made by Masia and Erasmus (2013) for Rand Water and Gauteng municipalities as a strategy to address non-revenue water (NRW).

Noga and Wolbring (2013) recommended using awareness campaigns to communicate and improve the promotion of water conservation. Therefore, it is recommended that the ORTDM conduct public awareness campaigns to educate the communities about the significance of water conservation and protecting water resources and biodiversity. On the other hand, Sigwela et al. (2017) recommended using platforms such as community Imbizos at the local authorities, community radio stations, print media and social networks to communicate water conservation and demand management information. The use of similar platforms is recommended for ORTDM.

Lastly, it is recommended that ORTDM adopts and integrates the "green infrastructure concept" as a tool in planning and designing its water supply infrastructure to protect the environment and preserve its natural resources. This approach was also recommended by Vithi-Masiza, Botha and Mbanga (2023) as a tool to ensure sustainable building practices for the Kento-on-Sea Eco Village project.

5.4 LIMITATIONS OF THE STUDY

Given the limited research conducted around sustainability integration for South African municipalities and the relatively recent emergence of the importance of sustainability in local government, the researcher struggled to access literature related to the specific context of the research (integration of sustainability in municipalities); however, this also presented an opportunity for the researcher to widen the search to incorporate municipalities outside South Africa. The other limiting factor was the sample size; the original targeted sample was twelve (12) participants; however, only seven (7) could be interviewed. The achieved sample size is deemed adequate for qualitative single-case study research (Mthuli, Ruffin and Singh, 2022). Lastly, the researcher is an employee of the Department of Local Government and Traditional Affairs; therefore, subjectivity and conflict of interest had to be avoided.

5.5 RECOMMENDATIONS FOR FURTHER RESEARCH

Due to the limitations of this study, the focus of interviews was on individuals within ORTDM and did not include the perception of other stakeholders beyond the municipal administration. However, for future research, it is recommended to explore the integration of sustainability principles in municipal water supply distribution systems development programmes with a focus on incorporating the perceptions of stakeholders beyond the municipal administration. This entails examining innovative collaboration models involving municipal administrations, communities, non-governmental organisations (NGOs), and professional service providers to foster sustainability in water supply distribution. The research would contribute to a more comprehensive understanding of how sustainability principles can be effectively integrated into municipal water supply systems development programmes while considering the diverse perspectives and interests of stakeholders beyond the municipal administration.

5.6 CONCLUSION

In conclusion, this dissertation has explored the complex process of integrating sustainability principles into the municipal water supply distribution systems development programmes, focusing on an Eastern Cape District Municipality in South Africa. Essentially, the researcher aimed to evaluate the integration of sustainability principles to improve the resilience of water supply distribution systems in the ORTDM. Through comprehensive analysis and evaluation, it has become apparent that despite progress made, significant challenges and opportunities persist in seamlessly integrating sustainability into water services management practices.

The underpinning theory adopted for the study is resilience theory. Marchese, Reynolds, Bates, Morgan, Clark and Linkov (2018: 1276) state that “increasing resilience of a system makes the systems more sustainable”. Thus, recognising the relationship between sustainability and

resilience allows for the application of resilience theory as the guiding principle in municipal water infrastructure development programmes, offering a comprehensive approach to enhancing both organisational and systems resilience. Therefore, by integrating resilience principles into planning, design, and management processes, municipalities can cultivate adaptive capacities within their organisational structures while simultaneously improving the resilience of water supply distribution systems (Ahern, 2011). This holistic approach recognises the interconnectedness between organisational and systems resilience, enabling municipalities to effectively navigate uncertainties and challenges while ensuring the provision of reliable and sustainable water services to communities. Therefore, as municipalities strive for a more sustainable future, collaboration among municipal policymakers, private sector agencies, and communities is paramount, necessitating the exploration of interdisciplinary approaches, sustainable strategies and innovative solutions (Ahern, 2013).

The study makes significant contributions to the water sector, particularly for municipalities in South Africa. It identifies key challenges and obstacles municipalities face in enhancing service delivery sustainably. The study expands on the traditional Triple Bottom Line (TBL) considerations to include technical (engineering) and project management integration aspects. The relevant recommendations provide municipalities with clear guidance on crucial aspects to consider and manage for effective sustainability integration.

The study also has important implications for policy development. It highlights the need for municipal policies to align better with sustainability principles and provides insights on achieving this alignment. Policymakers can use these insights to create regulations and guidelines that promote sustainable water management practices.

Furthermore, the dissertation emphasises the importance of a long-term vision for water supply distribution systems. It advocates for development approaches that meet immediate needs while also considering future impacts of climate change, population growth, and other socio-economic factors. This progressive approach is crucial for developing resilient and adaptable water supply distribution systems.

Drawing insights from this dissertation, the water sector can move forward with renewed determination to establish resilient, equitable, and environmentally responsible water supply systems. By implementing the study's recommendations, municipalities like ORTDM and other Water Services Authorities can overcome current challenges and leverage opportunities to achieve their strategic objectives, including integrating sustainability. This approach ensures that water supply distribution systems meet the current generation's needs and are equipped to

handle future demands, thereby enhancing the community's overall well-being and development.

Fundamentally, the journey toward sustainability is ongoing, marked by numerous challenges and opportunities for transformative change. Thus, as municipalities embark on a journey to ensure access to sustainable water services, they do so with a shared commitment to using ecosystem infrastructure sustainably.

REFERENCES

Aadnesgaard, V. and Willows, G., 2016. Audit outcomes and the level of service delivery within local government municipalities in South Africa. *Corporate Ownership and Control*, 13(2), pp.546–555. https://doi.org/10.22495/cocv13i2c3p5.

Aarseth, W., Ahola, T., Aaltonen, K., Økland, A. and Andersen, B., 2017. Project sustainability strategies: A systematic literature review. *International Journal of Project Management*, 35(6), pp.1071–1083. https://doi.org/10.1016/j.ijproman.2016.11.006.

Ababio, E.P., 2004. Enhancing community participation in developmental local government for improved service delivery. 39 no 2, pp.272–289.

AbouAssi, K., Bowman, A.O., Johnston, J.M., Bauer, Z. and Tran, L., 2021. Relations, resources, and costs: exploring cross-sectoral collaboration at the local level in a developing country. *International Public Management Journal*, 24(5), pp.1–28. https://doi.org/10.1080/10967494.2020.1853292.

Adeyeye, K., Gibberd, J. and Chakwizira, J., 2020. Water marginality in rural and peri-urban communities. *Journal of Cleaner Production*, 273, pp.1–26. https://doi.org/10.1016/j.jclepro.2020.122594.

Ahern, J., 2011. From fail-safe to safe-to-fail: Sustainability and resilience in the new urban world. *Landscape and Urban Planning*, 100(4), pp.341–343. https://doi.org/10.1016/j.landurbplan.2011.02.021.

Ahern, J., 2013. Urban landscape sustainability and resilience: the promise and challenges of integrating ecology with urban planning and design. *Landscape Ecology*, 28(6), pp.1203–1212. https://doi.org/10.1007/s10980-012-9799-z.

Aiyetan, A.O. and Das, D.K., 2021. Evaluation of the Factors and Strategies for Water Infrastructure Project Delivery in South Africa. *Infrastructures*, 6(5), p.65. https://doi.org/10.3390/infrastructures6050065.

Allen, A., 2001. Urban sustainability under threat: The restructuring of the fishing industry in Mar del Plata, Argentina. *Development in Practice*, 11(2–3), pp.152–173. https://doi.org/10.1080/09614520120056324.

Amaral, A.L., Martins, R. and Dias, L.C., 2023. Drivers of water utilities' operational performance – An analysis from the Portuguese case. *Journal of Cleaner Production*, 389, pp.1–15. https://doi.org/10.1016/j.jclepro.2023.136004.

Amarasinghe, P., Liu, A., Egodawatta, P., Barnes, P., McGree, J. and Goonetilleke, A., 2017. Modelling Resilience of a Water Supply System under Climate Change and Population Growth Impacts. *Water Resources Management*, 31(9), pp.2885–2898. https://doi.org/10.1007/s11269-017-1646-1.

Bahadur, A.V., Ibrahim, M. and Tanner, T., 2013. Characterising resilience: unpacking the concept for tackling climate change and development. *Climate and Development*, 5(1), pp.55–65. https://doi.org/10.1080/17565529.2012.762334.

Bakshi, B.R. and Fiksel, J., 2003. The quest for sustainability: Challenges for process systems engineering. *AIChE Journal*, 49(6), pp.1350–1358. https://doi.org/10.1002/aic.690490602.

Basiago, A.D., 1999. Economic, social, and environmental sustainability in development theory and urban planning practice. pp.145–161.

Batista, M., Goyannes Gusmão Caiado, R., Gonçalves Quelhas, O.L., Brito Alves Lima, G., Leal Filho, W. and Rocha Yparraguirre, I.T., 2021. A framework for sustainable and integrated municipal solid waste management: Barriers and critical factors to developing countries. *Journal of Cleaner Production*, 312, pp.1–44. https://doi.org/10.1016/j.jclepro.2021.127516.

Baumgartner, R.J. and Ebner, D., 2010. Corporate sustainability strategies: sustainability profiles and maturity levels. *Sustainable Development*, 18(2), pp.76–89. https://doi.org/10.1002/sd.447.

Bhamra, R., Dani, S. and Burnard, K., 2011. Resilience: the concept, a literature review and future directions. *International Journal of Production Research*, 49(18), pp.5375–5393. https://doi.org/10.1080/00207543.2011.563826.

Bieber, N., Ker, J.H., Wang, X., Triantafyllidis, C., van Dam, K.H., Koppelaar, R.H.E.M. and Shah, N., 2018. Sustainable planning of the energy-water-food nexus using decision making tools. *Energy Policy*, 113, pp.584–607. https://doi.org/10.1016/j.enpol.2017.11.037.

Bikam, P. and Chakwizira, J., 2021. Municipal asset operations and maintenance performance in metropolitan and rural municipalities in Gauteng Province and Vhembe District Local Municipalities, South Africa. *Cogent Engineering*, 8(1), pp.1–24. https://doi.org/10.1080/23311916.2021.1935409.

Boin, A. and van Eeten, M.J.G., 2013. The Resilient Organization. *Public Management Review*, 15(3), pp.429–445. https://doi.org/10.1080/14719037.2013.769856.

Boström, M., 2012. The problematic social dimension of sustainable development: the case of the Forest Stewardship Council. *International Journal of Sustainable Development & World Ecology*, 19(1), pp.3–15. https://doi.org/10.1080/13504509.2011.582891.

Braun, V. and Clarke, V., 2006. Using thematic analysis in psychology. *Qualitative Research in Psychology*, 3(2), pp.77–101. https://doi.org/10.1191/1478088706qp063oa.

Braun, V. and Clarke, V., 2021. One size fits all? What counts as quality practice in (reflexive) thematic analysis? *Qualitative Research in Psychology*, 18(3), pp.328–352. https://doi.org/10.1080/14780887.2020.1769238.

Brioso, X., 2015. Integrating ISO 21500 Guidance on Project Management, Lean Construction and PMBOK. *Procedia Engineering*, 123, pp.76–84. https://doi.org/10.1016/j.proeng.2015.10.060.

Bruhn-Tysk, S. and Eklund, M., 2002. Environmental impact assessment — a tool for sustainable development? A case study of biofuelled energy plants in Sweden. pp.129–144.

Buluma, P.I., Keror, I.K. and Bonuke, J.M., 2013. Institutional Related Factors Affecting the Implementation of Strategic Plans in Local Authorities in Kenya: A Case of Municipal Council of Eldoret. *International Journal of Business and Management*, 8(10), pp.81–85. https://doi.org/10.5539/ijbm.v8n10p81.

Burnard, K. and Bhamra, R., 2011. Organisational resilience: development of a conceptual framework for organisational responses. *International Journal of Production Research*, 49(18), pp.5581–5599. https://doi.org/10.1080/00207543.2011.563827.

Calabrese, A., Costa, R., Levialdi, N. and Menichini, T., 2019. Integrating sustainability into strategic decision-making: A fuzzy AHP method for the selection of relevant sustainability issues. *Technological Forecasting and Social Change*, 139, pp.155–168. https://doi.org/10.1016/j.techfore.2018.11.005.

Ceschin, F. and Gaziulusoy, I., 2016. Evolution of design for sustainability: From product design to design for system innovations and transitions. *Design Studies*, 47, pp.118–163. https://doi.org/10.1016/j.destud.2016.09.002.

Cmy, C., 2019. A Guide for Master's & Doctoral Students at Rhodes University. pp.1–104.

Correia, M.S., 2019. Sustainability: An Overview of the Triple Bottom Line and Sustainability Implementation. *International Journal of Strategic Engineering*, 2(1), pp.29–38. https://doi.org/10.4018/IJoSE.2019010103.

Da Silva, J., 2021. Producing 'good enough' automated transcripts securely: Extending Bokhove and Downey (2018) to address security concerns. *Methodological Innovations*, pp.1–11.

Dempsey, N., Bramley, G., Power, S. and Brown, C., 2011. The social dimension of sustainable development: Defining urban social sustainability. *Sustainable Development*, 19(5), pp.289–300. https://doi.org/10.1002/sd.417.

Diao, K., 2021. Towards resilient water supply in centralized control and decentralized execution mode. *Journal of Water Supply: Research and Technology-Aqua*, 70(4), pp.449–466. https://doi.org/10.2166/aqua.2021.162.

Duchek, S., 2020. Organizational resilience: a capability-based conceptualization. *Business Research*, 13(1), pp.215–246. https://doi.org/10.1007/s40685-019-0085-7.

Echebarria, C., Barrutia, J.M., Eletxigerra, A., Hartmann, P. and Apaolaza, V., 2018. Local sustainability processes worldwide: a systematic review of the literature and research agenda. *Journal of Environmental Planning and Management*, 61(8), pp.1289–1317. https://doi.org/10.1080/09640568.2017.1342611.

Fageha, M.K. and Aibinu, A.A., 2013. Managing Project Scope Definition to Improve Stakeholders' Participation and Enhance Project Outcome. *Procedia - Social and Behavioral Sciences*, 74, pp.154–164. https://doi.org/10.1016/j.sbspro.2013.03.038.

Fallon, A., Jones, R.W. and Keskinen, M., 2022. Bringing resilience-thinking into water governance: Two illustrative case studies from South Africa and Cambodia. *Global Environmental Change*, 75, pp.1–17. https://doi.org/10.1016/j.gloenvcha.2022.102542.

Fathalizadeh, A., Hosseini, M.R., Silvius, A.J.G., Rahimian, A., Martek, I. and Edwards, D.J., 2021. Barriers impeding sustainable project management: A Social Network Analysis of the Iranian construction sector. *Journal of Cleaner Production*, 318, pp.1–16. https://doi.org/10.1016/j.jclepro.2021.128405.

Folke, C., Carpenter, S.R., Walker, B., Scheffer, M., Chapin, T. and Rockström, J., 2010. Resilience Thinking: Integrating Resilience, Adaptability and Transformability. *Ecology and Society*, 15(4), pp.1–9. https://doi.org/10.5751/ES-03610-150420.

Freeman, R.E., 2004. The Stakeholder Approach Revisited. pp.228–254.

George, R.A., Siti-Nabiha, A.K., Jalaludin, D. and Abdalla, Y.A., 2016. Barriers to and enablers of sustainability integration in the performance management systems of an oil and gas

company. *Journal of Cleaner Production*, 136, pp.197–212. https://doi.org/10.1016/j.jclepro.2016.01.097.

Goel, A., Ganesh, L.S. and Kaur, A., 2019. Sustainability integration in the management of construction projects: A morphological analysis of over two decades' research literature. *Journal of Cleaner Production*, 236, pp.1–23. https://doi.org/10.1016/j.jclepro.2019.117676.

Guba, E.G., 1981. Criteria for assessing the trustworthiness of naturalistic inquiries. *ECTJ*, 29(2), pp.75–91. https://doi.org/10.1007/BF02766777.

Haigh, E.H., Fox, H. and Davies-Coleman, H., 2010. Framework for local government to implement integrated water resource management linked to water service delivery. *Water SA*, [online] 36(4). https://doi.org/10.4314/wsa.v36i4.58424.

Hale, J., Legun, K., Campbell, H. and Carolan, M., 2019. Social sustainability indicators as performance. *Geoforum*, 103, pp.47–55. https://doi.org/10.1016/j.geoforum.2019.03.008.

Harrison, P., 2001. The genealogy of South Africa's Integrated Development Plan. *Third World Planning Review*, 23(2), pp.175–193. https://doi.org/10.3828/twpr.23.2.q4172h26466148n3.

Harrison, P., Todes, A. and Watson, V., 2008. *Planning and transformation: learning from the post-apartheid experience*. The RTPI library series. London ; New York: Routledge.

Hilding-Rydevik, T., Håkansson, M. and Isaksson, K., 2011. The Swedish Discourse on Sustainable Regional Development: Consolidating the Post-political Condition. *International Planning Studies*, 16(2), pp.169–187. https://doi.org/10.1080/13563475.2011.561062.

Hill, R.C. and Bowen, P.A., 1997. Sustainable construction: principles and a framework for attainment. *Construction Management and Economics*, 15(3), pp.223–239. https://doi.org/10.1080/014461997372971.

Holden, E., Linnerud, K. and Banister, D., 2017. The Imperatives of Sustainable Development: The Imperatives of Sustainable Development. *Sustainable Development*, 25(3), pp.213–226. https://doi.org/10.1002/sd.1647.

Holling, C.S., 1973. Resilience and Stability of Ecological Systems. 4, pp.1–23.

Joslin, R. and Müller, R., 2015. Relationships between a project management methodology and project success in different project governance contexts. *International Journal of Project Management*, 33(6), pp.1377–1392. https://doi.org/10.1016/j.ijproman.2015.03.005.

Juan-García, P., Butler, D., Comas, J., Darch, G., Sweetapple, C., Thornton, A. and Corominas, L., 2017. Resilience theory incorporated into urban wastewater systems management. State of the art. *Water Research*, 115, pp.149–161. https://doi.org/10.1016/j.watres.2017.02.047.

Kallio, H., Pietilä, A.-M., Johnson, M. and Kangasniemi, M., 2016. Systematic methodological review: developing a framework for a qualitative semi-structured interview guide. *Journal of Advanced Nursing*, 72(12), pp.2954–2965. https://doi.org/10.1111/jan.13031.

Kiesnere, A.L. and Baumgartner, R.J., 2019. Sustainability management emergence and integration on different management levels in smaller large-sized companies in Austria. *Corporate Social Responsibility and Environmental Management*, pp.1607–1626. https://doi.org/10.1002/csr.1854.

Kotzé, L.J., 2010. Phiri, the plight of the poor and the perils of climate change: time to rethink environmental and socio-economic rights in South Africa? *Journal of Human Rights and the Environment*, 1(2), pp.135–160. https://doi.org/10.4337/jhre.2010.02.01.

Krantz, V. and Gustafsson, S., 2021. Localizing the sustainable development goals through an integrated approach in municipalities: early experiences from a Swedish forerunner. *Journal of Environmental Planning and Management*, 64(14), pp.2641–2660. https://doi.org/10.1080/09640568.2021.1877642.

Kuhlman, T. and Farrington, J., 2010. What is Sustainability? *Sustainability*, 2(11), pp.3436–3448. https://doi.org/10.3390/su2113436.

Labuschagne, C. and Brent, A.C., 2005. Sustainable Project Life Cycle Management: the need to integrate life cycles in the manufacturing sector. *International Journal of Project Management*, 23(2), pp.159–168. https://doi.org/10.1016/j.ijproman.2004.06.003.

Lebek, K., Twomey, M. and Krueger, T., 2021. Municipal Failure, Unequal Access and Conflicts Over Water: A Hydrosocial Perspective on Water Insecurity of Rural Households in KwaZulu-Natal, South Africa. *South Africa*, 14(1), pp.271–292.

Leigh, N. and Lee, H., 2019. Sustainable and Resilient Urban Water Systems: The Role of Decentralization and Planning. *Sustainability*, 11(3), pp.1–17. https://doi.org/10.3390/su11030918.

Leung, L., 2015. Validity, reliability, and generalizability in qualitative research. *Journal of Family Medicine and Primary Care*, 4(3), pp.324–327. https://doi.org/10.4103/2249-4863.161306.

Li, H., Xia, Q., Wen, S., Wang, L. and Lv, L., 2019. Identifying Factors Affecting the Sustainability of Water Environment Treatment Public-Private Partnership Projects. *Advances in Civil Engineering*, 2019, pp.1–15. https://doi.org/10.1155/2019/7907234.

Marchese, D., Reynolds, E., Bates, M.E., Morgan, H., Clark, S.S. and Linkov, I., 2018. Resilience and sustainability: Similarities and differences in environmental management applications. *Science of The Total Environment*, 613–614, pp.1275–1283. https://doi.org/10.1016/j.scitotenv.2017.09.086.

Masia, O.A. and Erasmus, L.D., 2013. Smart metering implementation for enabling Water Conservation and water demand management: An investigation in Gauteng, South Africa. In: *2013 Africon*. [online] AFRICON 2013. Pointe-Aux-Piments, Mauritius: IEEE. pp.1–5. https://doi.org/10.1109/AFRCON.2013.6757631.

Masuku, M.M. and Jili, N.N., 2019. Public service delivery in South Africa: The political influence at local government level. *Journal of Public Affairs*, 19(4), pp.1–7. https://doi.org/10.1002/pa.1935.

McGregor, S.L.T. and Murnane, J.A., 2010. Paradigm, methodology and method: intellectual integrity in consumer scholarship: Paradigm, methodology and method. *International Journal of Consumer Studies*, 34(4), pp.419–427. https://doi.org/10.1111/j.1470-6431.2010.00883.x.

McIntosh, M.J. and Morse, J.M., 2015. Situating and Constructing Diversity in Semi-Structured Interviews. *Global Qualitative Nursing Research*, 2, pp.1–12. https://doi.org/10.1177/2333393615597674.

Metaxas, T. and Psarropoulou, S., 2021. Sustainable Development and Resilience: A Combined Analysis of the Cities of Rotterdam and Thessaloniki. *Urban Science*, 5(4), p.78. https://doi.org/10.3390/urbansci5040078.

Mnguni, S. and Subban, M., 2022. Audit Outcome Challenges in Local Government. 13(1), pp.144–172.

Mokgethi, D.M. and van der Waldt, G., 2020. The Application of Project Management Methodology for Municipal Infrastructure Grant Projects. 28(4), pp.126–144.

Moloto, A., Mkhomazi, S. and Worku, Z., 2020. Factors Contributing to Poor Service Delivery in South African Rural Communities. pp.645–652.

Morelli, J., 2011. Environmental Sustainability: A Definition for Environmental Professionals. *Journal of Environmental Sustainability*, 1(1), pp.1–10. https://doi.org/10.14448/jes.01.0002.

Morgan, H., 2022. Conducting a Qualitative Document Analysis. *The Qualitative Report*. [online] https://doi.org/10.46743/2160-3715/2022.5044.

Morgan, R.K., 2012. Environmental impact assessment: the state of the art. *Impact Assessment and Project Appraisal*, 30(1), pp.5–14. https://doi.org/10.1080/14615517.2012.661557.

Morrison-Saunders, A. and Therivel, R., 2006. Sustainability Integration and Assessment. *Journal of Environmental Assessment Policy and Management*, 08(03), pp.281–298. https://doi.org/10.1142/S1464333206002529.

Morse, J.M., 1991. Approaches to Qualitative-Quantitative Methodological Triangulation: *Nursing Research*, 40(2), pp.120–123. https://doi.org/10.1097/00006199-199103000-00014.

Morse, J.M., Barrett, M., Mayan, M., Olson, K. and Spiers, J., 2002. Verification Strategies for Establishing Reliability and Validity in Qualitative Research. *International Journal of Qualitative Methods*, 1(2), pp.13–22. https://doi.org/10.1177/160940690200100202.

Mthuli, S.A., Ruffin, F. and Singh, N., 2022. 'Define, Explain, Justify, Apply' (DEJA): An analytic tool for guiding qualitative research sample size. *International Journal of Social Research Methodology*, 25(6), pp.809–821. https://doi.org/10.1080/13645579.2021.1941646.

Muller, H., 2014. The South African Experience on Legal, Institutional and Operational Aspects of the Rights to Water and Sanitation. *Aquatic Procedia*, 2, pp.35–41. https://doi.org/10.1016/j.aqpro.2014.07.006.

Nangoli, S., Namiyingo, S., Kabagambe, L., Namono, R., Jaaza, M. and Ngoma, M., 2016. Stakeholder participation: An empirical investigation. *Afr. J. Bus. Manage.*, 10(8), pp.182–186.

Nathaniel, S.P., Nwulu, N. and Bekun, F., 2021. Natural resource, globalization, urbanization, human capital, and environmental degradation in Latin American and Caribbean countries. *Environmental Science and Pollution Research*, 28(5), pp.6207–6221. https://doi.org/10.1007/s11356-020-10850-9.

Nkosi, S.M., 2015. Factors Affecting Strategy Implementation: A Case Study of A Local Municipality in Mpumalanga Province, South Africa. *European Journal of Business and Management*, pp.29–35.

Noga, J. and Wolbring, G., 2013. Perceptions of Water Ownership, Water Management, and the Responsibility of Providing Clean Water. *Water*, 5(4), pp.1865–1889. https://doi.org/10.3390/w5041865.

Nzewi, O., Ijeoma, E., Sibanda, M. and Sambumbu, A., 2016. Culture of Work in Municipal Government in South Africa: A Study of Selected Municipalities in the Eastern Cape. 51(1), pp.38–57.

O.R. Tambo District Municipality, 2020. O.R. Tambo District Municipality - Integrated Development Plan (2020/2021). pp.1–204.

Ortolano, L. and Shepherd, A., 1995. Environmental Impact Assessment: Challenges and Opportunities. *Impact Assessment*, 13(1), pp.3–30. https://doi.org/10.1080/07349165.1995.9726076.

Pagano, A., Pluchinotta, I., Giordano, R. and Fratino, U., 2018. Integrating "Hard" and "Soft" Infrastructural Resilience Assessment for Water Distribution Systems. *Complexity*, 2018, pp.1–16. https://doi.org/10.1155/2018/3074791.

Parmar, B.L., Freeman, R.E., Harrison, J.S., Wicks, A.C., Purnell, L. and de Colle, S., 2010. Stakeholder Theory: *The State of the Art*. *Academy of Management Annals*, 4(1), pp.403–445. https://doi.org/10.5465/19416520.2010.495581.

Pasquini, L., Ziervogel, G., Cowling, R.M. and Shearing, C., 2015. What enables local governments to mainstream climate change adaptation? Lessons learned from two municipal case studies in the Western Cape, South Africa. *Climate and Development*, 7(1), pp.60–70. https://doi.org/10.1080/17565529.2014.886994.

Pathirana, A., Heijer, F. den and Sayers, P.B., 2021. Water Infrastructure Asset Management Is Evolving. *Infrastructures*, 6(6), pp.1–9. https://doi.org/10.3390/infrastructures6060090.

Patton, M.Q., 2002. Two Decades of Developments in Qualitative Inquiry: A Personal, Experiential Perspective. *Qualitative Social Work*, 1(3), pp.261–283. https://doi.org/10.1177/1473325002001003636.

Pearse, N., 2019. An Illustration of Deductive Analysis in Qualitative Research. [online] 18th European Conference on Research Methodology for Business and Management Studies. pp.1–13. https://doi.org/10.34190/RM.19.006.

Project Management Institute ed., 2008. *A guide to the project management body of knowledge (PMBOK guide)*. 4th ed ed. Newtown Square, Pa: Project Management Institute, Inc.

Rankoana, S.A., 2020. Climate change impacts on water resources in a rural community in Limpopo province, South Africa: a community-based adaptation to water insecurity.

International Journal of Climate Change Strategies and Management, 12(5), pp.587–598. https://doi.org/10.1108/IJCCSM-04-2020-0033.

Republic of South Africa, 1996. *The Constitution of the Republic of South Africa, 1996: as adopted on 8 May 1996 and amended on 11 October 1996 by the Constituent Assembly*. Pretoria: Department of Justice and Constitutional Development.

Republic of South Africa, 1998. National Environmental Management Act 107 of 1998. *Government Gzette (19519)*, 401, pp.1–72.

Republic of South Africa, 2009. State of local government in South Africa. Overview Report National State of Local Government Assessments Working Documents. Pretoria: Department of Co - operative Government and Traditional Affairs (COGTA). pp.1–89.

Rincón, C.A.R., Santos, J., Volker, L. and Rouwenhorst, R., 2021. Identifying Institutional Barriers and Enablers for Sustainable Urban Planning from a Municipal Perspective. *Sustainability*, 13(20), pp.1–24. https://doi.org/10.3390/su132011231.

Ritchie, J. and Lewis, J., 2003. Qualitative research practice: a guide for social science students and researchers. *Choice Reviews Online*, 41(03), pp.1–336. https://doi.org/10.5860/CHOICE.41-1319.

Rodina, L., 2019. Defining "water resilience": Debates, concepts, approaches, and gaps. *WIREs Water*, 6(2), pp.1–18. https://doi.org/10.1002/wat2.1334.

Roovers, G.J. and van Buuren, M.W., 2016. Stakeholder participation in long term planning of water infrastructure. *Infrastructure Complexity*, 3(1), pp.1–13. https://doi.org/10.1186/s40551-016-0013-3.

Russo, T., Alfredo, K. and Fisher, J., 2014. Sustainable Water Management in Urban, Agricultural, and Natural Systems. *Water*, 6(12), pp.3934–3956. https://doi.org/10.3390/w6123934.

Ruwanza, S. and Shackleton, C.M., 2016. Incorporation of environmental issues in South Africa's municipal Integrated Development Plans. *International Journal of Sustainable Development & World Ecology*, 23(1), pp.28–39. https://doi.org/10.1080/13504509.2015.1062161.

Ryan, A.B., 2006. Post-Positivist Approaches to Research. pp.12–26.

Saidi, T., 2010. Environmental Impact Assessment as a Policy Tool for Integrating Environmental Concerns in Development. (19), pp.1–18.

Sartori, D. and Catalano, G., 2013. Infrastructure Investment Long Term Contribution: Economic Development and Wellbeing. pp.1–19.

Savira, E.M. and Tasrin, K., 2018. Involvement of Local Wisdom as a Value and an Instrument for Internalization of Public Service Innovation. *Bisnis & Birokrasi Journal*, [online] 24(1). https://doi.org/10.20476/jbb.v24i1.9464.

Schlangen, E. and Sangadji, S., 2013. Addressing Infrastructure Durability and Sustainability by Self Healing Mechanisms - Recent Advances in Self Healing Concrete and Asphalt. *Procedia Engineering*, 54, pp.39–57. https://doi.org/10.1016/j.proeng.2013.03.005.

Sebidi, K. and Madue, S., 2018. Influencing Change in Municipalities Through Leadership: A Case Study of the City of Tshwane Municipality. pp.494–503.

Selala, M., Senzanje, A. and Dhavu, K., 2019. Requirements for sustainable operation and maintenance of rural small-scale water infrastructure in Limpopo Province, South Africa. *Water SA*, [online] 45(2 April). https://doi.org/10.4314/wsa.v45i2.16.

Sigwela, A., Elbakidze, M., Powell, M. and Angelstam, P., 2017. Defining core areas of ecological infrastructure to secure rural livelihoods in South Africa. *Ecosystem Services*, 27, pp.272–280. https://doi.org/10.1016/j.ecoser.2017.07.010.

Silvius, A.J.G. and Schipper, R.P.J., 2014. Sustainability in project management: A literature review and impact analysis. *Social Business*, 4(1), pp.63–96. https://doi.org/10.1362/204440814X13948909253866.

Silvius, G., 2017. Sustainability as a new school of thought in project management. *Journal of Cleaner Production*, 166, pp.1479–1493. https://doi.org/10.1016/j.jclepro.2017.08.121.

Silvius, G. and Marnewick, C., 2022. Interlinking Sustainability in Organizational Strategy, Project Portfolio Management and Project Management A Conceptual Framework. *Procedia Computer Science*, 196, pp.938–947. https://doi.org/10.1016/j.procs.2021.12.095.

Simpson, N.P., Simpson, K.J., Shearing, C.D. and Cirolia, L.R., 2019. Municipal finance and resilience lessons for urban infrastructure management: a case study from the Cape Town drought. *International Journal of Urban Sustainable Development*, 11(3), pp.257–276. https://doi.org/10.1080/19463138.2019.1642203.

Smakhtin, V., Ashton, P., Batchelor, A., Meyer, R., Murray, E., Barta, B., Bauer, N., Naidoo, D., Olivier, J. and Terblanche, D., 2001. Unconventional Water Supply Options in South

Africa: A Review of Possible Solutions. *Water International*, 26(3), pp.314–334. https://doi.org/10.1080/02508060108686924.

Smedby, N. and Quitzau, M.-B., 2016. Municipal Governance and Sustainability: The Role of Local Governments in Promoting Transitions: Municipal Governance and Sustainability. *Environmental Policy and Governance*, 26(5), pp.323–336. https://doi.org/10.1002/eet.1708.

Stuart, J., Collins, P., Alger, M. and Whitelaw, G., 2016. Embracing sustainability: the incorporation of sustainability principles in municipal planning and policy in four mid-sized municipalities in Ontario, Canada. *Local Environment*, 21(2), pp.219–240. https://doi.org/10.1080/13549839.2014.936844.

Swartz, C., Du Plessis, J., Burger, A. and Offringa, G., 2009. A desalination guide for South African municipal engineers. *Water SA*, 32(5), pp.641–647. https://doi.org/10.4314/wsa.v32i5.47845.

Trinder, J.C., 2008. Remote Sensing for Assessing Environmental Impacts Based on Sustainability Indicators. XXXVII, pp.1421–1428.

Tsibani, F., 2007. A literature review of the twinning approach in supporting developmental water services by water services institutions (WSIs) and water services authorities (WSAs) in South Africa. *Water SA*, 31(3), pp.335–344. https://doi.org/10.4314/wsa.v31i3.5223.

Vithi-Masiza, N., Botha, B. and Mbanga, S., 2023. Greening of Human Settlements in South Africa: A Case of Ndlambe Village. 8(5), pp.1987–1996.

Voce, A., 2005. Ensuring the credibility and trustworthiness of qualitative studies. p.3.

Wälitalo, L., Callaghan, E., Robèrt, K. and Broman, G., 2023. Understanding governance barriers and enablers for municipal and regional transition towards sustainability—Presenting a comprehensive diagnostic tool based on six case studies in Sweden. *Geo: Geography and Environment*, 10(1), pp.1–19. https://doi.org/10.1002/geo2.118.

Weaver, M.J.T., O'Keeffe, J., Hamer, N. and Palmer, C.G., 2019. A civil society organisation response to water service delivery issues in South Africa drives transformative praxis. Part 1: Emergence and practice. *Geoforum*, 107, pp.1–13. https://doi.org/10.1016/j.geoforum.2019.08.020.

Weyer, J., 2020. O.R. Tambo District Municipality Water Services Development Plan (2020/2021). 1, pp.1–153.

Wynberg, R.P. and Sowman, M., 2007. Environmental sustainability and land reform in South Africa: A neglected dimension. *Journal of Environmental Planning and Management*, 50(6), pp.783–802. https://doi.org/10.1080/09640560701609810.

Yazdani, A., Otoo, R.A. and Jeffrey, P., 2011. Resilience enhancing expansion strategies for water distribution systems: A network theory approach. *Environmental Modelling & Software*, 26(12), pp.1574–1582. https://doi.org/10.1016/j.envsoft.2011.07.016.

Yin, R.K., 2013. Validity and generalization in future case study evaluations. pp.321–332.

Zhong, Y. and Wu, P., 2015. Economic sustainability, environmental sustainability and constructability indicators related to concrete- and steel-projects. *Journal of Cleaner Production*, 108, pp.748–756. https://doi.org/10.1016/j.jclepro.2015.05.095.

Zhu, J., Manandhar, B., Truong, J., Ganapati, N.E., Pradhananga, N., Davidson, R.A. and Mostafavi, A., 2017. Assessment of Infrastructure Resilience in the 2015 Gorkha, Nepal, Earthquake. *Earthquake Spectra*, 33(1_suppl), pp.147–165. https://doi.org/10.1193/121116eqs231m.

Zvobgo, L., 2020. Performance evaluation of water supply services in Chitungwiza: How water supply services mirrors poor governance and lack of management. *Journal of Local Government Research and Innovation*, [online] 1. https://doi.org/10.4102/jolgri.v1i0.17.

APPENDICES

Appendix A – Interview Guide with questions for Semi-structured interviews

RESEARCH PROJECT TITLE:

INTEGRATING SUSTAINABILITY IN MUNICIPALITIES IN SOUTH AFRICA: AN EVALUATION OF AN EASTERN CAPE DISTRICT MUNICIPALITY'S WATER SUPPLY DISTRIBUTION SYSTEMS

Respondent's understanding of sustainability integration in ORTDM

To evaluate whether and how Oliver Reginald Tambo District Municipality (ORTDM) integrates sustainability principles (social, environmental, economic, engineering, and project management) in its water supply distribution systems development programmes.

SECTION 1

UNDERSTANDING SUSTAINABILITY & WATER SUPPLY DISTRIBUTION SYSTEMS

1. What is your understanding of sustainability?
2. What is your understanding of water supply distribution systems?

SECTION 2

INTEGRATING SUSTAINABILITY PRINCIPLES - STRATEGIES

a) Social Sustainability

Social Sustainability is defined as a set of actions and policies aimed at the improvement of quality of life but also the fair access and distribution of rights over the use and appropriation of the natural and built environment (Allen, 2001; Morrison-Saunders and Therivel, 2005).

1. How do you think the municipality's current water services planning and implementation strategies and processes promote proactive stakeholder participation, and how has the municipality performed in ensuring this objective is achieved?
2. What are the challenges - and opportunities for improvement - associated with ensuring proactive stakeholder participation?
3. How do you think the municipality's current water services planning and implementation strategies promote improved quality of life of communities, and how has the municipality performed?
4. What are the challenges - and opportunities for improvement - associated with achieving improved quality of life in ORTDM communities?
5. How do you think the municipality's current water services planning and implementation strategies promote the realisation of the right of fair access to water resources and water services, and how has the municipality performed?
6. What are the challenges - and opportunities for improvement - associated with achieving fair access to water resources and water services?
7. How do you think the municipality's current water services planning and implementation strategies promote equitable distribution of water infrastructure, and how has the municipality performed?

8. What are the challenges - and opportunities for improvement - associated with achieving equitable distribution of water infrastructure?
9. In your expert opinion, are there any additional aspects that pose challenges to the social sustainability of the water resources and water services provision at ORTDM? If so, please discuss these.
10. In your expert opinion, are there any additional social sustainability opportunities (not yet discussed) that you think exist for ORTDM to improve their water resources management and water services provision? If so, please discuss these.

---

b) Environmental Sustainability

Environmental Sustainability is understood as the rational management of natural resources and making sure that the over-extraction of these resources is prevented (Allen, 2001; Saikia et al., 2022; Morrison-Saunders and Therivel, 2005)

1. How do you think the municipality's current water services planning and implementation strategies promote the avoidance of adverse effects on natural resources, and how has the municipality performed?
2. What are the challenges - and opportunities for improvement - associated with avoiding the adverse effects on natural resources by ORTDM?
3. How do you think the municipality's current water services planning and implementation strategies promote efficient exploitation of natural resources, and how has the municipality performed?
4. What are the challenges - and opportunities for improvement - associated with the promotion of efficient exploitation of natural resources?
5. How do you think the municipality's current water services planning and implementation strategies promote the implementation of environmental protection and restoration programmes, and how has the municipality addressed this objective?
6. What are the challenges - and opportunities for improvement - associated with the implementation of environmental protection and restoration programmes?
7. In your expert opinion, are there any additional aspects that pose challenges to the environmental sustainability of the water resources and water services provision at ORTDM? If so, please discuss these.
8. In your expert opinion, are there any additional environmental sustainability opportunities (not yet discussed) that you think exist for ORTDM to improve their water resources management and water services provision? If so, please discuss these.

---

c) Economic Sustainability

Economic sustainability occurs when development intended to achieve social and environmental sustainability is financially feasible and does not cause irreversible damage to the natural resource base on which it depends (Allen, 2001; Morrison-Saunders and Therivel, 2005; Muarya et al., 2020).

1. How do you think the municipality's current water services planning and implementation strategies assist in ensuring the use of economic capital is on

developments that will not cause irreversible damage to the natural resources, and how has the municipality performed?

2. What are the challenges - and opportunities for improvement - associated with ensuring the use of economic capital is on developments that will not cause irreversible damage to natural resources?
3. How do you think the municipality's current water services planning and implementation strategies assist in ensuring financial investments made in developments will not compromise the financial position of the municipality, and how has the municipality performed?
4. What are the challenges - and opportunities for improvement - associated with ensuring financial investments made in developments will not compromise the financial position of the municipality?
5. How do you think the municipality's current water services planning and implementation strategies encourage efficient management and use of financial resources, and how has the municipality performed?
6. What are the challenges - and opportunities for improvement - associated with efficient management and the use of financial resources?
7. In your expert opinion, are there any additional aspects that pose challenges to the economic sustainability of the water resources and water services provision at ORTDM? If so, please discuss these.
8. In your expert opinion, are there any additional economic sustainability opportunities (not yet discussed) that you think exist for ORTDM to improve their water resources management and water services provision? If so, please discuss these.

---

d) Engineering Sustainability

Engineering Sustainability refers to ensuring the sustainable development of the project itself (physical infrastructure, e.g., Water Pipelines, Water Pumps, etc.), durability, operation, and maintenance capability, and the sustainability of technology used (Li et al., 2019: 5; Silvius and Schipper, 2014).

1. How do you think the municipality's current water services practices (e.g. planning/implementation strategies, policies) facilitate the delivery of durable water supply distribution systems, and how has the municipality performed?
2. What are the challenges - and opportunities for improvement - associated with ensuring the delivery of durable water supply distribution systems?
3. How do you think the municipality's current water services practices (e.g. planning/ implementation strategies, policies) ensure the availability of operation and maintenance capabilities, and how has the municipality made these capabilities available?
4. What are the challenges - and opportunities for improvement - associated with ensuring the availability of operation and maintenance capabilities?
5. How do you think the municipality's current water services practices (e.g. planning/ implementation strategies, policies) ensure the choice of infrastructure technology improves water supply reliability, and how has the municipality performed?
6. What are the challenges - and opportunities for improvement - associated with ensuring the choice of infrastructure technology improves water supply reliability?
7. How do you think the municipality's current water services practices (e.g. planning/implementation strategies, policies) ensure the choice of infrastructure

technology that promotes economic efficiency, and how has the municipality performed?

8. What are the challenges - and opportunities for improvement - associated with ensuring the choice of infrastructure technology promotes economic efficiency?

---

e) Project Management Sustainability

Project Management Sustainability refers to ensuring project delivery, such as physical infrastructure (e.g. water pipelines, water pumps, etc.), is done in a profitable, fair, transparent, safe, ethical, and environmentally friendly manner, resulting in physical infrastructure that is socially and environmentally acceptable throughout its life cycle (Li et al., 2019: 5; Silvius and Schipper, 2014).

1. How do you think the municipality's current water services planning and implementation strategies ensure water infrastructure delivery mechanisms do not promote the depletion of financial resources, and how would you describe the extent to which the municipality has achieved this objective?
2. What are the challenges - and opportunities for improvement - associated with ensuring that water infrastructure delivery mechanisms do not promote the depletion of financial resources?
3. How do you think the municipality's current water services planning and implementation strategies ensure water infrastructure delivery mechanisms are not harmful to the natural environment, and how would you describe the extent to which the municipality has achieved this objective?
4. What are the challenges - and opportunities for improvement - associated with ensuring the choice of water infrastructure delivery mechanisms are not harmful to the natural environment?
5. Please share your insights and opinions on how the municipality's current water services planning and implementation strategies are conducted in a transparent, fair, and ethical way? Furthermore, how do you think these practices include proactive stakeholder participation? Please elaborate on areas of success and also where you think improvements can be made in this regard.
6. What are the challenges - and opportunities for improvement - associated with ensuring that processes leading to the delivery of water supply distribution systems are performed in a transparent, fair, and ethical way that includes proactive stakeholder participation?

SECTION 3

UNDERSTANDING OF RESILIENCE THINKING AND RESILIENCE PRACTICES AT ORTDM WITH REGARDS TO WATER SUPPLY DISTRIBUTION SYSTEMS / WATER MANAGEMENT

Resilience

Resilience is defined as "the ability of an asset, organisation, community, and region to anticipate, absorb, resist, respond to, adapt to, and recover from a disturbance " (Carlson, Haffenden, Bassett, Buehring, Collins, Iii, Folga, Petit, Phillips, Verner and Whitfield, 2012: vii). Resilience, described in the context of water supply distribution systems, is "the ability of the system to return to its pre-disturbance state as quickly as

possible" (Rodina, 2019: 2). Further, to describe the resilience and sustainability relationship, Metaxas and Psarropoulou (2021: 1) assert that "resilience is a way of thinking that would lead to sustainability".

1. In your expert opinion, how well can ORTDM's current water services practices (e.g. planning/implementation strategies, policies) facilitate the delivery of water supply distribution systems that are able to recover from a disturbance to their pre-disturbance state as quickly as possible?
2. What are the challenges - and opportunities for improvement - associated with facilitating the delivery of water supply distribution systems that are able to recover from a disturbance to their pre-disturbance state as quickly as possible?
3. In your expert opinion, how well is the ability of ORTDM, to anticipate, respond to, and recover from a disturbance in its water supply distribution systems?
4. What are the challenges - and opportunities for improvement - associated with ORTDM's ability to anticipate, respond to and recover from a disturbance in its water supply distribution systems?
5. In your expert opinion, how well is the ability of ORTDM to absorb, resist, and adapt to a disturbance in its water supply distribution systems?
6. What are the challenges - and opportunities for improvement - associated with ORTDM's ability to absorb, resist, and adapt to a disturbance in its water supply distribution systems?
7. In your expert opinion, how well is the ability of ORTDM water supply distribution systems to absorb, resist, adapt to, and recover from a disturbance?
8. What are the challenges - and opportunities for improvement - associated with ORTDM water supply distribution systems to absorb, resist, adapt to, and recover from a disturbance?

CONCLUSION

In conclusion, are there any additional information or insights you would like to share around the sustainability and resilience considerations for ORTDM's water services infrastructure? If so, please feel free to discuss these now.

Thank you for your time and valuable participation

Appendix B – Example of Request for Permission to Conduct Research Letter

[redacted]

[redacted]

24 March 2023

Dear Sir,

REQUEST FOR PERMISSION TO CONDUCT RESEARCH IN ORTDM

My name is Zukani Maxwele (Student No. [redacted]), a registered Master of Business Administration (MBA) degree student at the Rhodes Business School at Rhodes University. My supervisor is Ms. Leticia Greyling. Through this letter, permission is requested from the Municipal Manager to conduct research in the Oliver Reginald Tambo District Municipality (ORTDM). The proposed topic of my research is: *Integration of sustainability in municipalities in South Africa: An evaluation of an Eastern Cape district municipality's water supply distribution systems*. The main aim of the research is to evaluate the integration of sustainability principles in an effort to improve the resilience of water supply distribution systems in the ORTDM. The objectives of the study are:

(a) To assess the integration of sustainability principles in the municipal water supply distribution system's development programmes.
(b) To investigate the challenges and opportunities associated with integrating sustainability principles into water supply distribution systems, as perceived by the municipality.
(c) To propose recommendations on how ORTDM can improve the sustainability of water supply services in an effort to improve their resilience.

The research will be undertaken through semi-structured interviews with ORTDM officials, the Portfolio Head Technical Services, and the analysis of important municipal documents pertinent to water infrastructure planning and development. The municipal documents to be analysed will include the Integrated Development Plan (IDP), Water Services Development Plan (WSDP), the ORTDM Annual Report, Audit Reports, and any other relevant documents necessary to achieve the research objectives.

Rhodes University, Research Office, Ethics
Ethics Coordinator: ethics-commitee@ru.ac.za
t: +27 (0) 46 603 7727 f: +27 (0) 86 616 7707
Room 220, Main Admin Building, Drostdy Road, Grahamstown, 6139

RHODES UNIVERSITY
Where leaders learn

The identity of all the municipal participants who voluntarily consent to participate will be treated with complete confidentiality. Anonymity will be provided, where requested. All the information provided will be kept confidential and will be used only for the purpose of the study.

I hereby seek assistance from the Municipal Manager's office to inform the proposed participants about the research and, where they agree, to share their contact details so the researcher can contact them directly to arrange interviews.

If you agree to the institution's participation, please complete and sign the attached Institution Consent Form and forward it back to the Research Student and the Supervisor. Should you require any further information, please do not hesitate to contact me or my supervisor. Our contact details are as follows:

Research Student:
Name: Zukani Maxwele
Contact Nr.: [redacted]
Email: [redacted]

Supervisor:
Name: Ms Leticia Greyling
Contact Nr.: [redacted]
Email: [redacted]

Upon completion of the study, I undertake to provide you with a copy of the summarised thesis report as feedback should you require it. Your permission to conduct this study will be greatly appreciated.

Yours sincerely,

Signature
Name: Zukani Maxwele

RHODES UNIVERSITY
Where leaders learn

Integration of sustainability in municipalities in South Africa: An evaluation of an Eastern Cape district municipality's water supply distribution systems

Institution Consent Form

Participation Consent
I consent for you to conduct your research in Oliver Reginald Tambo District Municipality (ORTDM) and approach ORTDM officials in the Water and Sanitation Services Department, the Integrated Development Planning Department, and the Portfolio Head Technical Services to participate in the proposed study titled, *"Integration of sustainability in municipalities in South Africa: An evaluation of an Eastern Cape district municipality's water supply distribution systems"*

I acknowledge and understand:

- The role of the institution is voluntary.
- I may decide to withdraw the institution's participation at any time without penalty.
- ORTDM officials in the Water and Sanitation Services Department, the Integrated Development Planning Department and the Portfolio Head Technical Services will be identified, informed about the research, and invited to participate, by the Municipal Managers Office.
- The Municipal Manager's Office will seek permission from the participants, to provide the researcher with their contact details and for the researcher to contact them directly for the interviews.
- The Municipal Manager's office will provide to the researcher the names and contact details of ORTDM officials to participate in the research before the researcher approaches or contacts the officials.
- Only ORTDM officials and councillor who consent will participate in the project.
- All information obtained will be treated in strictest confidence.
- The officials' and councillors' names will not be used and will not be identifiable in any written reports about the study.
- Participants may withdraw from the study at any time without penalty.
- A report of the findings will be made available to the institution.
- I may seek further information on the project from ZUKANI MAXWELE on [redacted]

Rhodes University, Research Office, Ethics
Ethics Coordinator: ethics-commitee@ru.ac.za
t: +27 (0) 46 603 7727 f: +27 (0) 86 616 7707
Room 220, Main Admin Building, Drostdy Road, Grahamstown, 6139

RHODES UNIVERSITY
Where leaders learn

• The full name of the municipality 'Oliver Reginald Tambo District Municipality' will be used in the final thesis report.	
AGREE	DISAGREE (i.e. the municipalty's name will be anonymised)

Full Name:		
Position:		
Signature:		
Date:		
Please return to:	**Student:** Zukani Maxwele Cell: [+ Email: or	**Supervisor:** Leticia Greyling Rhodes Business School Tel: [+ Email:

Rhodes University, Research Office, Ethics
Ethics Coordinator: ethics-commitee@ru.ac.za
t: +27 (0) 46 603 7727 f: +27 (0) 86 616 7707
Room 220, Main Admin Building, Drostdy Road, Grahamstown, 6139

Appendix C – Example of Participant Informed Consent Declaration Letter

RHODES UNIVERSITY
Where leaders learn

PARTICIPANT INFORMED CONSENT DECLARATION

(To be signed by research participant/s)

Project Title: ***Integration of sustainability in municipalities in South Africa: An evaluation of an Eastern Cape district municipality's water supply distribution systems.***

Zukani Maxwele – Student No: [redacted] *(the Researcher)* conducting his MBA research under the auspices of the **Rhodes Business School**, Rhodes University, has requested my permission to participate in the above-mentioned research project.

The nature and the purpose of the research project and of this informed consent declaration have been explained to me in a language that I understand.

I am aware that:

1. The purpose of the research project **is to *evaluate the integration of sustainability principles in an effort to improve the resilience of water supply distribution systems in the Oliver Reginald Tambo District Municipality (ORTDM).***

2. Rhodes University has given ethical clearance to this research project - **Ethics Approval Number:** [redacted] ***Approval Number),*** and I have seen/may request to see the clearance certificate by contacting the Ethics Coordinator (ethics-committee@ru.ac.za)

3. By participating in this research project I will be contributing towards **proposal of recommendations to improve the sustainability and resilience of water supply distribution systems in Oliver Reginald Tambo District Municipality.**

4. I will participate in the project by **responding to a set of interview questions.**

5. My participation is entirely voluntary and should I at any stage wish to withdraw from participating further, I may do so without any negative consequences.

6. I will not be compensated for participating in the research, but my out-of-pocket expenses will be reimbursed.

7. The following risks are associated with my participation: **Compromised anonymity - participants' anonymity will be discussed and provided where required, while signed consent will be required before participation. The research findings will be used only for academic purposes.**

Rhodes University, Research Office, Ethical Review
Ethics Coordinator: ethics-commitee@ru.ac.za
t: +27 (0) 46 603 7727 f: +27 (0) 86 616 7707
Room 204, Main Admin Building, Drostdy Road, Grahamstown, 6139

RHODES UNIVERSITY
Where leaders learn

8. The Researcher intends to publish the research results in the form of a ***Research Thesis Report,*** However, confidentiality and anonymity of records will be maintained and my name and identity will not be revealed to anyone who has not been involved in the conducting of the research, ***unless I indicate to the contrary/recognise that as a public figure my identity will inevitably be/become known, in which case I agree to accept the loss of anonymity.***

9. In terms of the Protection of Personal Information Act (No. 4 of 2013) it remains my right to request the Researcher to provide me with a detailed explanation of exactly how confidentiality and anonymity of the data I provide will be achieved. I may also request to know exactly how my personal information will be stored securely, for how long it will be stored.

10. If any data collected from me for this research project is to be used by the Researcher for any further study, I am to be informed in writing and my written consent requested again. I need not give consent for the new research if it is incompatible with the initial purpose of the present study (POPIA, s15(3)). Equally, I can simply reject the request. In such cases, a formal request needs to be made to me by the researcher via the Ethics Coordinator (ethics-committee@ru.ac.za).

11. In terms of the POPI Act, I possess the right to receive feedback about this research. This will take the form of **a copy of the examined and corrected summarized final thesis report** unless ***I elect not to receive this feedback.***

12. Any further questions that I might have regarding the nature of the research and/or my participation in it will be answered by **Zukani Maxwele; (email –** [redacted]

13. By signing this informed consent declaration, I am not waiving any legal claims, rights, or remedies. A copy of this informed consent declaration will be given to me, and the original will be kept on record by the Researcher.

14. I ***agree/disagree*** (delete inapplicable) to the Researcher's request to take photographs, or video of me as part of this research project, recognising that agreement here is likely to raise the risk of compromising my anonymity and that steps will be taken to ensure this will not happen if my consent is given.

15. I ***agree/disagree*** (delete inapplicable) to the Researcher's use of voice recording of my comments and opinions during interviews, the purpose of which is to ensure the accurate recording of my views/responses. Furthermore, I have the right to request a copy of the interview transcriptions to confirm that my opinions are accurately recorded

I, ..., have read the above information / confirm that the above information has been explained to me in a language that I understand, and I am aware of this document's contents. I have asked all questions that I

RHODES UNIVERSITY
Where leaders learn

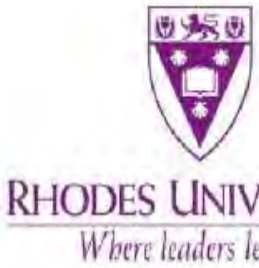
wished to ask, and these have been answered to my satisfaction. I fully understand what is expected of me during the research.

I have not been pressurised in any way, and I voluntarily agree to participate in the above-mentioned project.

.....	.....	.....
Participants signature	**Witness**	**Date**

Rhodes University, Research Office, Ethical Review
Ethics Coordinator: ethics-commitee@ru.ac.za
t: +27 (0) 46 603 7727 f: +27 (0) 86 616 7707
Room 204, Main Admin Building, Drostdy Road, Grahamstown, 6139

Appendix D – Ethics Approval Letter (Provisional Approval)



Rhodes University Human Research Ethics Committee
PO Box 94, Makhanda, 6140, South Africa
t: +27 (0) 46 603 7727
f: +27 (0) 46 603 8822
e: ethics-committee@ru.ac.za

https://www.ru.ac.za/researchgateway/ethics/

14 March 2023

Mr Zukani Maxwele

Email: [redacted]

Review Reference: [redacted]

Dear Mr Zukani Maxwele

Re: Integration of sustainability in municipalities in South Africa: An evaluation of an Eastern Cape district municipality's water supply distribution systems.

Researcher: Mr Zukani Maxwele

Supervisor: Ms Leticia Greyling.

This letter confirms that the above research proposal has been reviewed by the Rhodes University Human Research Ethics Committee (RU-HREC) and **PROVISIONALLY APPROVED PENDING PERMISSION/GATEKEEPER LETTER(S).**

Gatekeeper permission is required from: [redacted]

Once the Gatekeeper permission letter/s has been received please forward it to the Ethics Coordinator, in order to finalize your ethics approval.

Sincerely,

Dr Janet Hayward

Chair: Rhodes University Human Research Ethics Committee, RU-HREC

cc: Ethics Coordinator

Appendix E – Ethics Approval Letter (Final Approval)

Rhodes University Human Research Ethics Committee
PO Box 94, Makhanda, 6140, South Africa
t: +27 (0) 46 603 7727
f: +27 (0) 46 603 8822
e: ethics-committee@ru.ac.za

https://www.ru.ac.za/researchgateway/ethics/

2 June 2023

zukani maxwele

Email: [redacted]

Review Reference: [redacted]

Dear zukani maxwele

Title: Integration of sustainability in municipalities in South Africa: An evaluation of an Eastern Cape district municipality's water supply distribution systems.

Researcher: zukani maxwele

Supervisor: Ms Leticia Greyling

This letter confirms that the above research proposal has been reviewed and **APPROVED** by the Rhodes University Human Research Ethics Committee (RU-HREC). Your Approval number is: [redacted]

Approval has been granted for 1 year. An annual progress report will be required in order to renew approval for an additional period. You will receive an email notifying you when the annual report is due.

Please ensure that the ethical standards committee is notified should any substantive change(s) be made, for whatever reason, during the research process. This includes changes in investigators. Please also ensure that a brief report is submitted to the ethics committee on the completion of the research. The purpose of this report is to indicate whether the research was conducted successfully, if any aspects could not be completed, or if any problems arose that the ethical standards committee should be aware of. If a thesis or dissertation arising from this research is submitted to the library's electronic theses and dissertations (ETD) repository, please notify the committee of the date of submission and/or any reference or cataloguing number allocated.

Sincerely,

Dr Janet Hayward

Chair: Rhodes University Human Research Ethics Committee, RU-HREC

cc: Ethics Coordinator

Appendix F – Ethics Approval Letter - (Approval Renewal)

RHODES UNIVERSITY
Where leaders learn

Rhodes University Human Research Ethics Committee
PO Box 94, Makhanda, 6140, South Africa
t: +27 (0) 46 603 7727
f: +27 (0) 46 603 8822
e: ethics-committee@ru.ac.za
NHREC Registration number: RC-241114-045
https://www.ru.ac.za/researchgateway/ethics/

09 May 2024

Mr Zukani Maxwele

Email: [redacted]

Review Reference: [redacted]

Dear Mr. Maxwele,

Re: Human ethics renewal application: Integration of sustainability in municipalities in South Africa: An evaluation of an Eastern Cape district municipality's water supply distribution systems.

Researcher: Mr. Zukani Maxwele

Supervisors: Ms. Leticia Greyling

This letter confirms that the above Annual Report has been reviewed and **APPROVED** by the Rhodes University Human Research Ethics Committee (RU-HREC). Your Approval number is: [redacted]

Approval has been granted for 1 year. An annual progress report will be required in order to renew approval for an additional period.

Please ensure that the Human Research Ethics Committee is notified should any substantive change(s) be made, for whatever reason, during the research process. This includes changes in investigators. Please also ensure that a brief report is submitted to the ethics committee on the completion of the research. The purpose of this report is to indicate whether the research was conducted successfully, if any aspects could not be completed, or if any problems arose that the Human Research Ethics Committee should be aware of. If a thesis or dissertation arising from this research is submitted to the library's electronic theses and dissertations (ETD) repository, please notify the committee of the date of submission and/or any reference or cataloguing number allocated.

Sincerely,

Janet Hayward

Dr Janet Hayward

Chair: Rhodes University Human Research Ethics Committee, RU-HREC

cc: Ethics Coordinator

Appendix G – Consolidated List of Initial Challenges

#No	Initial Challenge	Key Themes	Source Reference		
			Respondent	IDP	WSDP
1	Financial resources limitations	Resources Challenges	1, 2, 3, 4, 5, 6 & 7	Yes	Yes
2	Natural resources limitations (existing rivers are listed rivers)		2, 3, 4, 5 & 6		
3	Material not available in close proximity (few suppliers)		2, 5, 6 & 7		
4	Access to technology limitations		2, 6 & 7	Yes	
5	Under-capacitated internal personnel (Skills shortage / Expert-Personnel shortage)		1, 3, 4, 5, 6 & 7	Yes	Yes
6	High population growth	Social Challenges	6	Yes	
7	Community protests		2 & 6		
8	High poverty and illiteracy levels among communities		1, 3 & 6	Yes	
9	High unemployment and inequality rate among communities		2	Yes	
10	Significant water services backlogs			Yes	Yes
11	Vandalism of infrastructure and theft		3, 5 & 6		Yes

12	Lack of community satisfaction and buy-in		2, 4, 5, 6 & 7		
13	Lack of project management and engineering standards in ORTDM	Technical Challenges	1, 4, 6 & 7	Yes	Yes
14	Lack of standardised infrastructure design guidelines		4, 5, 6 & 7		
15	Project delivery delays		3, 4, 6 & 7	Yes	
16	Lack of Operations and Maintenance Plans				
17	Poor maintenance of existing infrastructure			Yes	Yes
18	Old and non-functional water schemes				Yes
19	Weak organisational resilience capabilities "inability to respond quickly to disruptions"	Governance Challenges	2, 3, 4, 5, 6 & 7		
20	Political interference		1		
21	Delays in obtaining water use licenses		2		
22	Delays in project approvals for funding		6		
23	Lack of internal staff training programmes		4,5,6 & 7		
24	Pollution in the environment				Yes

25	Lack of holistic approach to Water Conservation and Demand Management and high water losses	Environmental Challenges		Yes	Yes
26	Biodiversity loss due to “land grabs”		3	Yes	