

# ENVIRONMENTAL ASSESSMENT REPORT FOR THE PROPOSED SOLID WASTE DISPOSAL FACILITY (LANDFILL) AT TSUMKWE SETTLEMENT, OTJOZONDJUPA REGION, NAMIBIA

MARCH 2026

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<b>PROJECT NAME</b>	ENVIRONMENTAL SCOPING REPORT FOR THE PROPOSED SOLID WASTE DISPOSAL FACILITY (LANDFILL) AT TSUMKWE SETTLEMENT, OTJOZONDJUPA REGION, NAMIBIA
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## LIST OF ACRONYMS AND ABBREVIATIONS

<b>Acronym</b>	<b>Meaning</b>
BID	Background Information Document
C44	District Road C44 (Tsumkwe-Grootfontein Road)
ECC	Environmental Clearance Certificate
EA	Environmental Assessment
EAP	Environmental Assessment Practitioner
ECO	Environmental Control Officer
EIA	Environmental Impact Assessment
EMA	Environmental Management Act (Act No. 7 of 2007)
EMP	Environmental Management Plan
FAO	Food and Agriculture Organization of the United Nations
GN	Government Notice
I&APs	Interested and Affected Parties
MAWLR	Ministry of Agriculture, Water and Land Reform
MEFT	Ministry of Environment, Forestry and Tourism
MET	Ministry of Environment and Tourism (former designation)
MR74	Main Road 74
NDP	National Development Plan
NSA	Namibia Statistics Agency
PPE	Personal Protective Equipment
TA	Traditional Authority
WHO	World Health Organization

## DECLARATION

I hereby declare that I am the author of this document. I affirm that the content is accurate, complete, and based on the data and findings available at the time of its preparation. I confirm that the report has been prepared in accordance with the applicable environmental regulations and standards, and that I take full responsibility for its contents.



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## **EXECUTIVE SUMMARY**

This Environmental Scoping Report evaluates the potential environmental and socio-economic impacts associated with the proposed development of a controlled solid waste disposal facility (landfill) at Tsumkwe Settlement in the Otjozondjupa Region, Namibia. The project is proposed by the Otjozondjupa Regional Council in response to ongoing uncontrolled waste disposal, which currently pose significant risks to public health, groundwater resources, and the surrounding natural environment.

The proposed landfill aims to regulate waste management in Tsumkwe, and the development is aligned with the Environmental Management Act (2007) and the National Solid Waste Management Strategy, which promote sustainable waste management practices and the establishment of controlled disposal facilities.

The receiving environment is environmental sensitivity, because Tsumkwe is located within the Kalahari sand system, which is associated with highly permeable soils and a strong reliance on groundwater resources. The area also falls within the Nyae Nyae Conservancy, supporting ecologically significant woodland vegetation and diverse wildlife, including protected tree species, large mammals such as elephants, and endangered species such as the African wild dog.

The impact assessment identified several potential environmental and social impacts associated with the planning, construction, and operational phases of the project. The most significant risks include groundwater contamination from leachate, disturbance to wildlife movement corridors, loss of vegetation (including protected species), and increased human-wildlife conflict. Mitigation of these impacts are of medium to high significance, and implementation of appropriate measures, these impacts can be reduced to acceptable levels.

Key mitigation measures include the installation of an engineered liner system and leachate collection infrastructure, development of stormwater management controls, implementation of wildlife-proof perimeter fencing, and minimisation of vegetation clearing, engagement with local communities and conservancy structures are essential to sustainable operation.

The project will also generate important positive public health and environmental conditions through the elimination of uncontrolled dumping, enhanced protection of soil and water resources, and the provision of limited employment opportunities during both construction and operation phases. The formalisation of waste management services represents a significant improvement in service delivery for the Tsumkwe settlement.

A key recommendation of this assessment is the reduction of the originally proposed landfill footprint from 30.62 hectares to a smaller, more manageable area of 2 hectares. This will significantly reduce ecological disturbance, limit habitat fragmentation, and minimise impacts on wildlife movement, while still meeting the waste disposal needs of the settlement. The proposed Tsumkwe landfill is considered environmentally acceptable and necessary, provided that all recommended mitigation measures are strictly implemented and monitored.

## 1. INTRODUCTION

### 1.1. Background

Solid waste management remains a significant environmental and public health challenge in many rural and peri-urban settlements in Namibia, where formal waste disposal infrastructures are limited or absent. In such areas, waste is commonly disposed of through uncontrolled dumping and open burning, practices that contribute to land degradation, air and water pollution, public health risks, and negative impacts on livestock and natural ecosystems. Tsumkwe settlement, situated northeast of Namibia in the Otjozondjupa Region and home to the previously marginalised San community, is no exception. The growing population in the Tsumkwe constituency has prompted the Otjozondjupa Regional Council to intervene and transition waste management from informal, unregulated disposal to a structured, community-led approach aimed at reducing environmental hazards.

In response to these challenges, the Tsumkwe Settlement Development Committee (SDC) convened an ordinary meeting on 15 May 2025, during which concerns were raised regarding improper waste management practices and their negative effects on environmental conditions and the local tourism industry. During this meeting, the Committee resolved that a formal landfill facility should be established as a priority intervention, and further agreed that the proposed landfill site be located on the western side of the settlement, with the necessary relocation processes to be undertaken in accordance with applicable planning and environmental requirements.

To date, waste in the settlement continues to be disposed of on open land in an uncontrolled manner. The proposed landfill is therefore intended to replace these practices with a regulated, environmentally compliant waste disposal system. The development forms part of the Regional Council's broader mandate to improve environmental health conditions, protect natural resources, and ensure sustainable service delivery within the region, in compliance with the National Waste Management Strategy.

### 1.2. Scope of the Environmental Impact Assessment

This Environmental Impact Assessment (EIA) has been undertaken to identify, assess, and evaluate the potential environmental, social, and economic impacts associated with the establishment and operation of the proposed solid waste disposal facility at Tsumkwe Settlement.

The scope of the assessment covers the full lifecycle of the project, including planning, site preparation, construction, operation, closure, and post-closure rehabilitation. Key aspects assessed include, but are not limited to:

- Impacts on soil, surface water and groundwater resources;

- Air quality impacts associated with dust, odours, and emissions;
- Vegetation clearance and impacts on communal land use;
- Public health and safety risks;
- Socio-economic implications for surrounding communities; and
- Cumulative and long-term environmental risks.

The findings of the assessment are supported by an Environmental Management Plan (EMP), which outlines mitigation, monitoring, and management measures to ensure that potential impacts are avoided, minimised, or effectively managed.

### 1.3. **Proponent**

The project proponent is the Otjozondjupa Regional Council, a statutory body mandated to provide governance, infrastructure development, and service delivery within the Otjozondjupa Region in terms of the Regional Council's Act (Act 22 of 1992). This mandate includes responsibility for the planning and implementation of waste management services within settlements under its jurisdiction.

The proposed landfill facility aligns with the Regional Council's objectives to improve waste management practices, enhance environmental protection, and comply with national environmental legislation and policy requirements.

### 1.4. **Environmental Assessment Practitioner**

Envirofficient Consultants cc was appointed as the independent Environmental Assessment Practitioner (EAP) to undertake the Environmental Impact Assessment and to prepare the Environmental Management Plan for the proposed landfill.

The EAP conducted the assessment in accordance with the Environmental Management Act, 2007 (Act No. 7 of 2007), and the Environmental Impact Assessment Regulations, (2012). The assessment was undertaken with due professional care, objectivity, and independence. Envirofficient Consultants cc has no financial or other vested interest in the proposed development, apart from its role as an environmental consultant, the CV of the EAP is attached as **Annexure A**.

### 1.5. **Regulatory Framework and Need for Environmental Assessment**

The Environmental Management Act, 2007 (Act No. 7 of 2007), and the Environmental Impact Assessment Regulations, 2012, require that listed activities may not be undertaken without an Environmental Impact Assessment and the issuance of an Environmental Clearance Certificate (ECC) by the Ministry of Environment, Forestry and Tourism (MEFT).

The proposed Tsumkwe solid waste disposal facility triggers the following listed activities in terms of the EIA Regulations:

- **Activity 2:** Construction of facilities for waste sites, treatment of waste, and disposal of waste;
- **Activity 4:** Clearance of forested areas or vegetation requiring authorisation under the Forest Act (No. 12 of 2001).

Accordingly, an Environmental Impact Assessment is legally required to evaluate the potential impacts of the proposed development and to ensure that appropriate mitigation and management measures are implemented. This EIA provides the basis upon which MEFT may consider the application for an Environmental Clearance Certificate for the proposed landfill at Tsumkwe Settlement.

## 2. PROJECT DESCRIPTION

### 2.1. Overview of the Proposed Development

The proposed project entails the establishment and operation of a formal, controlled solid waste disposal facility (landfill) at Tsumkwe settlement, in Otjozondjupa Region. The landfill is intended to serve Tsumkwe Settlement and its immediate surroundings by providing a designated, regulated site to dispose general, non-hazardous solid waste.

The proposed facility aims to replace existing informal waste disposal practices, including illegal dumping and open burning, which currently pose environmental, health, and safety risks. The landfill will be developed and operated in accordance with the Environmental Management Act, 7 of 2007, relevant regulations, and the mitigation measures set out in the Environmental Management Plan (EMP).

### 2.2. Location and Site Description

Tsumkwe is located in the north-eastern part of the Otjozondjupa Region in Namibia, close to the international boundary with Botswana. The settlement lies approximately 300 km east of Grootfontein, which serves as the nearest major town and primary service centre for the area. Tsumkwe is 55 km west of the Dobe Border Post along the C44 route, providing a direct link between Namibia and Botswana. Its location places it within a remote and sparsely populated part of the region, characterized by limited infrastructure and accessibility primarily via gravel roads.

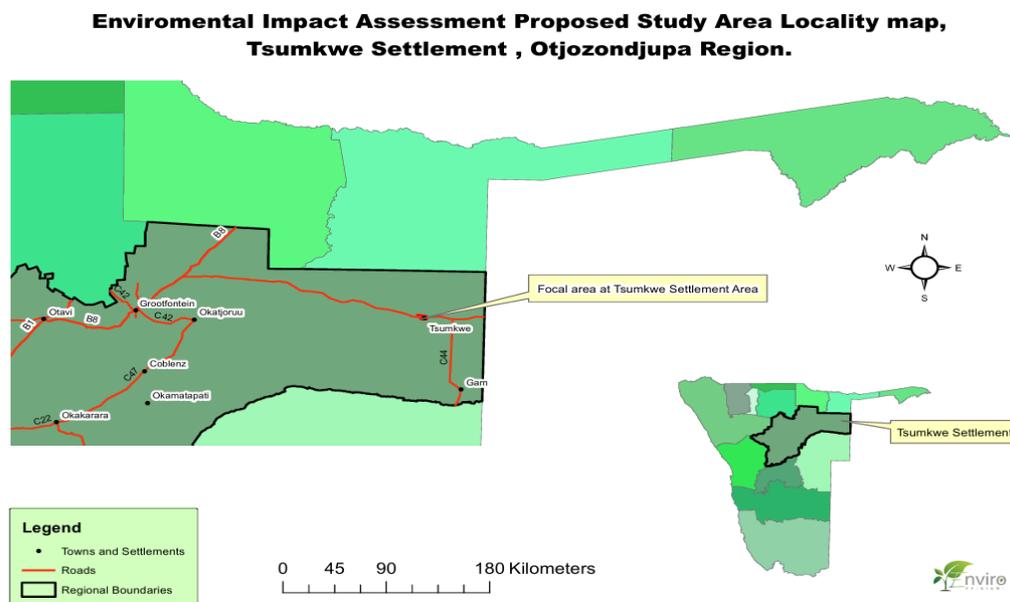


Figure 1 Landfill relative map.

The proposed landfill site is situated within the Tsumkwe settlement townland, as declared in Namibia Government Gazette No. 2867 on 2 December 2002. The site is located approximately 1.8 kilometres west of the existing developed area of the settlement. The location was selected to maintain appropriate separation from residential areas while remaining accessible for waste collection and site management activities.

Surrounding land uses include:

- The proposed site is located within a predominantly natural environment characterized by woodland vegetation, as Tsumkwe lies within a forested Kalahari savanna landscape. The settlement of Tsumkwe falls within the boundaries of the Nyae Nyae Conservancy, an area recognized for community-based natural resource management and conservation.
- To the western boundary of the site is the Ministry of Agriculture, Water and Land Reform animal breeding facility.
- The northern, southern and eastern side of the site is bordered predominantly by natural forested land. The C44 (MR74) road runs approximately 1 km to the north of the site.
- There are no known proclaimed heritage sites within the footprint of the proposed development. However, the broader area holds significant cultural value associated with the San people, who are indigenous to the region.

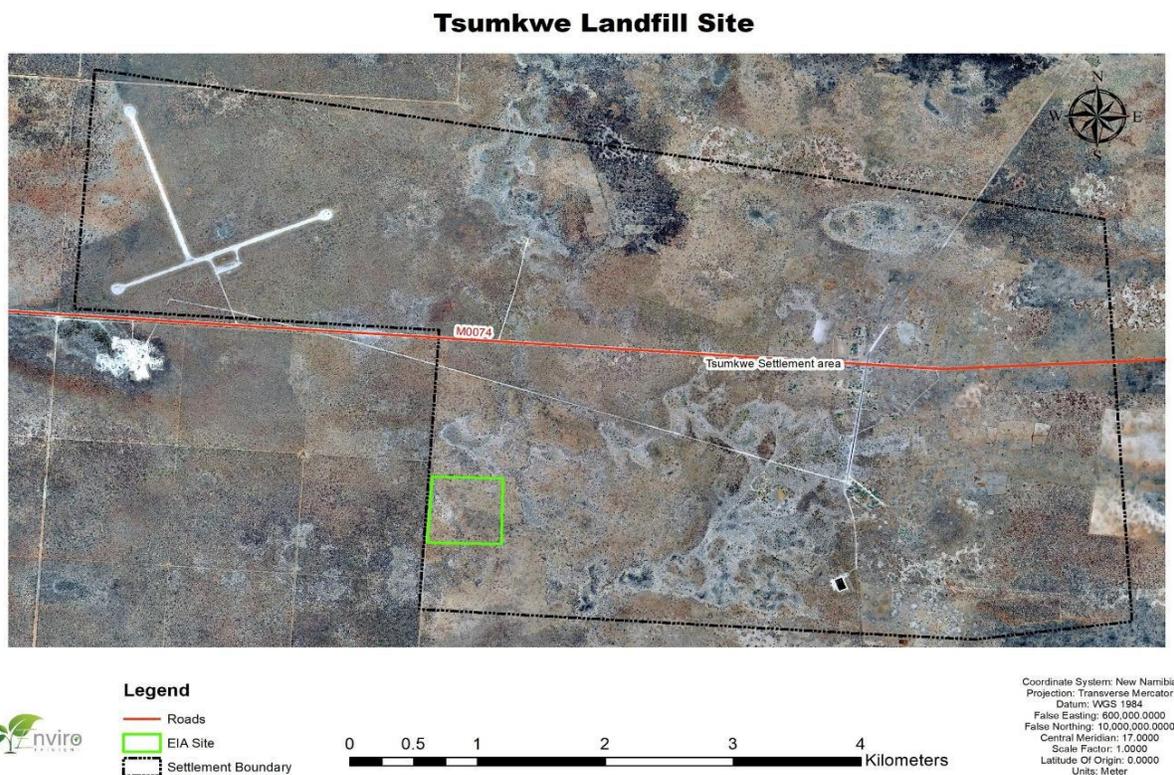


Figure 2 Site plan Tsumkwe proposed Landfill

### 2.3. **Need for the Project**

The proposed waste disposal site is required to address the serious solid waste management challenges currently experienced in Tsumkwe settlement. At present, the current dumping site is disposed of at an unfenced and unmanaged informal site, with no control mechanism for handling or disposal. Population growth and changing consumption patterns within the settlement have led to increasing waste volumes that can no longer be sustainably managed under existing practices.

The absence of a formal disposal facility undermines compliance with national environmental legislation and limits the Regional Council's ability to provide effective waste management services.

The National Solid Waste Management Strategy advocates for establishment of formal waste management facilities in all populated areas, including settlements administered by Regional Council. The Environmental Management Act further recognizes waste management as a key component of sustainable development.

The proposed landfill in Tsumkwe is expected to:

- Provide a designated and regulated location for solid waste disposal;
- Reduce environmental pollution and public health risks;
- Protect surrounding ecosystems, wildlife, and water resources;
- Improve compliance with national environmental legislation and policies; and
- Create opportunities for local employment related to site operation and waste management activities.

### 2.4. **Suitability of the Proposed Site**

According to the United States Environmental Protection Agency (2023), landfill site suitability is determined by a combination of environmental, geological, hydrological, social, and regulatory factors designed to minimize risks to human health and the environment. Key considerations include soil type soil, hydrogeological stability to prevent leachate contamination. Geological stability are essential to ensure long-term containment integrity.

Adequate buffer zones from residential areas and environmentally sensitive habitats are essential to minimize potential adverse impacts, unless such impacts can be effectively mitigated through careful design and the full implementation of a comprehensive environmental management plan. Site selection is further influenced by accessibility to transportation networks, compatibility with existing land uses, and compliance with applicable local and national environmental regulations (World Health Organization, 2018).

Prior to project approval, a comprehensive Environmental Impact Assessment (EIA) is typically conducted to systematically evaluate these factors, ensuring that potential environmental and social risks are identified, assessed, and appropriately managed.

Tsumkwe settlement is located within an ecologically sensitive area characterized by natural vegetation and free-ranging wildlife throughout the townland and its surrounding areas. The environmental sensitivity of the region necessitates careful planning in order to balance conservation priorities with essential municipal services. It is undisputed that the growing population and increasing generation of solid waste requires a formalised and suitable site for waste disposal that meets environmental and planning requirements.



Figure 3 Location of the current uncontrolled and informal dumping site

The current dumpsite serving Tsumkwe is situated outside the proclaimed and gazetted settlement boundary along the C44 road on the eastern side of the settlement, and operates in an uncontrolled manner with waste disposed of directly onto open land, and open fire burning. The site is not compliant with prevailing land-use planning and regulatory requirements for formal waste management facilities. Environmental observations from the site visit indicate that the location is unsuitable for continued use, as it is characterized by undulating terrain with exposed hard rock and intersected by multiple active drainage lines, while also being surrounded by low laying floodplains. These conditions significantly influence natural surface water flow, increasing the risk of uncontrolled runoff, erosion, and leachate generation, which in turn heightens the potential for contamination of surrounding soil and water resources during rainfall seasons.



*Figure 4 Images from the current uncontrolled dumping site*

## 2.5. **Description of the Proposed Landfill Facility**

The proposed solid waste disposal facility will occupy approximately 306,197 m<sup>2</sup> (30.62 hectares) and is located to the west of the Tsumkwe settlement area, within the proclaimed settlement boundaries. The site has been identified as suitably distanced from residential zones, thereby providing an adequate buffer to minimise potential impacts on surrounding communities. Although the terrain is generally flat, the area is characterised by relatively dense vegetation.

The development is planned as a small-scale, controlled landfill facility designed to accommodate general domestic and other non-hazardous waste generated within Tsumkwe Settlement and its surrounding areas. Hazardous, medical, and industrial waste streams will not be accepted at the facility. This restriction is intended to ensure compliance with applicable environmental management standards and to minimise risks to human health and the environment.

Implementation of the landfill will occur over a three-year period in a phased manner to ensure structured development and effective environmental oversight. Phase One will comprise site preparation activities, including vegetation clearing, site demarcation, and installation of perimeter fencing to secure the area. Phase Two will involve the construction of the landfill infrastructure and associated facilities. The Final Phase will focus on completion of construction works, operational readiness, and commissioning of the facility. The proposed landfill will incorporate the following key components:

- A designated active waste disposal cell;
- Perimeter fencing with a controlled, lockable entrance gate;
- Access roads for waste collection vehicles;
- Stormwater management systems to prevent erosion and uncontrolled runoff;
- Designated areas for waste placement, compaction, and cover material storage; and
- Operational areas to support routine site management activities.

Waste will be deposited in a controlled and supervised manner, compacted in layers to optimise airspace utilisation, and periodically covered with soil or other suitable material. This operational approach will minimise odours, windblown litter, pest attraction, and fire risks. Over time, waste will undergo natural biological decomposition processes typical of managed landfill environments.

The overall suitability of the site and the proposed development will be further evaluated in subsequent chapters, taking into account the findings of specialist assessments, stakeholder consultations, and recommended mitigation measures.

The landfill will be developed incrementally to allow for effective management and to extend its operational lifespan.



*Figure 5 Proposed Landfill site*

## 2.6. **Access and Services**

Access to the waste disposal site will be via an existing gravel road located approximately 3 km west of the C44 road linking Tsumkwe to Grootfontein. Minor road upgrades may be required to support regular waste collection and operational traffic. Limited water supply during construction will be required for dust suppression and fire control, sourced from existing supplies where available. No permanent on-site accommodation is proposed.

## 2.7. Waste Volumes, Scale, and Operational Approach

At present, reliable quantitative data on waste generation rates and total waste volumes within Tsumkwe is not available due to the absence of a formalized waste collection and recording system. Historically, solid waste management practices within the settlement have largely consisted of informal dumping and open burning, which do not allow for systematic measurement or accurate estimation of waste quantities generated. Consequently, baseline data required for precise landfill capacity planning is currently limited.

In the absence of site-specific data, planning assumptions may be guided by established waste generation rates for rural and low-density settlements. According to the World Bank (2018), per capita municipal solid waste generation in low-income, rural areas typically ranges between 0.2 and 0.55 kg per person per day, depending on consumption patterns and levels of economic activity. United Nations Environment Programme (2015) reports that small rural settlements in developing regions generally produce waste volumes at the lower end of this range due to reduced packaging waste and lower commercial activity. For planning purposes, a conservative generation rate within this range may be applied to estimate projected waste volumes until site-specific data becomes available.

The proposed landfill is therefore designed as a small-scale, controlled facility to be developed and operated incrementally. This phased and adaptive approach will enable waste volumes to be monitored and recorded once formal operations commence. Accurate data collection during operation will allow for refinement of cell design, adjustment of operational practices, and more reliable projections of the facility's lifespan. Waste quantities and disposal rates will be systematically documented and incorporated into ongoing adaptive management measures under the Environmental Management Plan (EMP), ensuring that the facility remains appropriately scaled and environmentally compliant over time.

## 2.8. Consideration of Alternatives

According to the Otjozondjupa Regional Council, the site alternatives were considered in selecting the proposed site, which include:

- **Alternative sites:** The proposed site was selected based on land availability of land, its accessibility, separation from sensitive receptors such as the residential area and the airport, and general compatibility with surrounding land uses.
- **Design and operational alternatives:** Incremental development and controlled waste placement were preferred to reduce environmental risks and improve manageability.
- **No-go alternative:** In accordance with the Environmental Management Act, reasonable alternatives to the proposed activity have been considered, including alternative site options and the No-Go Alternative. The No-Go Alternative would result in the continuation

of informal waste disposal practices, with associated environmental degradation and public health risks.

- **Wind direction:** The prevailing wind direction is predominantly from east to west at an average speed of approximately 11.6 km/h .

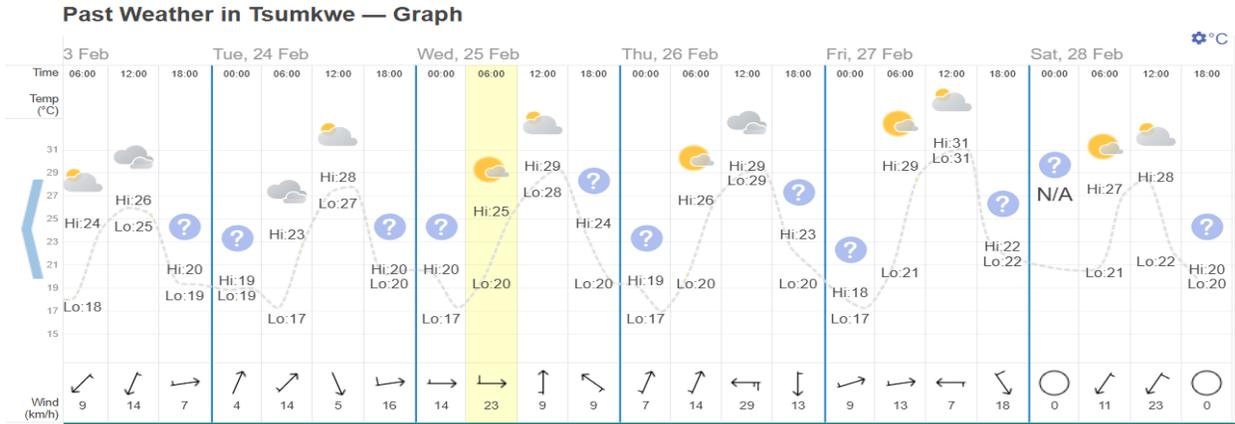


Figure 6 Wind graph from the time and date weather report (<https://www.timeanddate.com/weather/@876747/historic>)

### 3. LEGISLATION

The pursuit of sustainability is guided by a sound legislative framework. In this section relevant legal instruments as well as their relevant provisions have been surveyed. An explanation is provided regarding how these provisions apply to this project in particular.

*Table 1 Applicable Legal instruments*

THEME	LEGISLATIVE / POLICY INSTRUMENT	RELEVANT PROVISIONS	RELEVANCE TO TSUMKWE LANDFILL PROJECT
Constitutional Framework	Namibian Constitution	Article 95(l): obligation to promote ecosystem integrity and sustainable use of natural resources for present and future generations.	Provides the overarching legal foundation for environmental protection, sustainable waste management, and safeguarding of groundwater, vegetation, and public health at Tsumkwe settlement.
Environmental Assessment & Governance	Environmental Management Act 7 of 2007 (EMA)	Section 27: Listed activities require Environmental Clearance Certificate (ECC). Section 3: Environmental management principles, pollution prevention, waste minimisation, protection of water resources. Section 2(b-c): Public participation.	The proposed landfill is a listed activity and requires an ECC. The Act governs the entire EIA process, impact assessment, public consultation, and EMP implementation.
	Environmental Impact Assessment Regulations (GN 30 of 2012)	Sections 8, 15 & 21: Requirements for scoping, EIA reporting, public consultation, and consideration of alternatives.	Guides preparation of the Scoping/EIA Reports, public notices, public meetings, and issues-and-response trail for Tsumkwe.
Solid Waste Management	Pollution Control and Waste Management Bill	Provides for integrated waste management, licensing of disposal sites, prohibition of illegal dumping, and control of hazardous and general waste.	Provides policy direction and best practice guidance for landfill design, operation, closure, and waste handling at Tsumkwe, pending promulgation.
	National Solid Waste Management Strategy (2018-2028)	Promotes waste hierarchy (reduce, reuse, recycle), controlled landfill development, and protection of environmental and human health.	Aligns the Tsumkwe landfill with national objectives to replace uncontrolled dumping with engineered disposal facilities.

	Hazardous Substances Ordinance No. 14 of 1974	The Ordinance applies to the manufacture, sale, use, disposal and dumping of hazardous substances, as well as their import and export. Its primary purpose is to prevent hazardous substances from causing injury, ill-health or the death of human beings.	Hydrocarbons handled during the construction phase may be hazardous thus careful handling and management is vital to prevent spills, explosions, ill-health or death.
Public Health & Safety	Public Health Act 36 of 1919	Section 119 prohibits nuisances injurious or dangerous to health, including refuse accumulation, odours, dust, pests, and contaminated water.	Requires the landfill to prevent odour, dust, vermin, and water contamination that could affect Tsumkwe residents and surrounding communal areas.
	Labour Act 11 of 2007	Sections 39-47: Working conditions; Section 135: Health and safety regulations.	Applies to construction and operation workers, ensuring safe handling of waste, machinery, and hazardous materials.
	Health and Safety Regulations GN 156 of 1997	Occupational health standards, sanitation, exposure to harmful substances, and workplace safety.	Governs safety of landfill workers, including PPE use, sanitation facilities, and exposure to waste-related hazards.
Water Resources Protection	Water Act 54 of 1956 (still in force)	Section 21: Permit required for disposal of effluent. Section 23: Prohibits pollution of surface and groundwater; liability for remediation.	Highly relevant due to sandy soils, high permeability, and reliance on groundwater. Requires leachate control, stormwater management, and groundwater protection.
Climate & Air Quality	Atmospheric Pollution Prevention Ordinance 11 of 1976	Regulates dust, smoke, and noxious gases; Part IV addresses dust control.	Governs dust generation during construction, landfill operations, vehicle movements, and windblown litter under semi-arid, windy conditions.
Land Use & Tenure	Communal Land Reform Act 5 of 2002	Allocation of land rights via Traditional Authorities and Communal Land Boards.	Legitimises the allocation of communal land.
Local & Regional Governance	Local Authorities Act 23 of 1992	Empowers local authorities to provide waste management services, regulate refuse disposal, and promulgate by-laws.	Governs long-term operation, regulation, and enforcement of waste management services once Tsumkwe is under local authority administration.

	Regional Councils Act 22 of 1992	Mandates regional planning, infrastructure development, and service delivery oversight.	Provides institutional oversight by the Otjozondjupa Regional Council for waste management planning and compliance.
Heritage & Archaeology	National Heritage Act 27 of 2004	Section 48: Permit required for disturbance or relocation of heritage resources; chance finds procedure.	Applies to potential graves or cultural sites associated with the San (Bushmen) groups. Chance finds during construction must be reported and managed legally.
Vegetation & Biodiversity	Forest Act 12 of 2001	Protection of listed tree species; permits required for removal; protection of vegetation near watercourses.	Relevant due to Thornbush Savanna vegetation and potential protected species within or adjacent to the landfill footprint.
	Nature Conservation Ordinance 4 of 1975	Protection of indigenous flora and fauna.	Requires mitigation of impacts on savanna-adapted species and pest attraction risks associated with waste disposal.
Traffic & Infrastructure	Roads Ordinance 17 of 1972	Road reserves, access controls, vehicle movement, and protection of proclaimed roads.	Governs access road use, increased landfill truck traffic, and protection of existing road infrastructure near Tsumkwe.
Socio-Economic & Resettlement	National Compensation Policy (2008)	Framework for compensation where land or livelihoods are affected by development.	Guides compensation or mitigation where grazing land or livelihoods are impacted by landfill development.
Public Participation & Governance	EIA Regulations (GN 30 of 2012)	Section 21: Mandatory public consultation, notices, meetings, and documentation of stakeholder inputs.	Provides the legal basis for the public consultation process undertaken in Tsumkwe, including meetings, notices, and issue tracking.
Development Planning	Vision 2030 & NDPs	Promote sustainable development, service delivery, and environmental protection.	Supports the landfill as basic service infrastructure improving environmental health and governance in a rural settlement context.

Provisions that have emerged as being of particular significance, owing to the nature of associated impacts, include those pertaining to water (protection of surface and ground sources) vegetation (protection of plant species) public health (prevention of nuisances, like air pollution, caused to citizens) and traffic (regulations pertaining to proclaimed roads).

## 4. RECEIVING ENVIRONMENT

An assessment of the potential environmental and social impacts associated with the proposed landfill requires a thorough understanding of the existing conditions of the receiving environment. This section describes the baseline biophysical and socio-economic characteristics of the project area and its immediate surroundings. These baseline conditions provide the reference against which potential impacts arising from the construction, operation, closure, and rehabilitation of the landfill are identified, assessed, and managed.

### 4.1. The Biophysical Environment

#### 4.1.1. Climate

Tsumkwe is situated within the semi-arid to arid climatic zone of north-eastern Namibia, a region strongly influenced by the Kalahari system. The area is characterized by hot summers, cool winters, low annual rainfall, and high evaporation rates (Ministry of Environment and Tourism, 2011). According to Atlas of Namibia (2022), the mean annual rainfall in the Tsumkwe area generally ranges between approximately 400 mm and 450 mm, falling predominantly during the summer months of November to March, often in the form of short, high-intensity convective storms.

Temperatures are typically high during summer, frequently exceeding 30°C, while winter months (June and July) can experience minimum temperatures below 10°C, with marked diurnal temperature variation. The region is characterized by low humidity and high potential evaporation, which significantly exceeds precipitation for most of the year (Food and Agriculture Organization, 2006).

These climatic conditions are important in the context of landfill development, as they influence waste decomposition rates, leachate generation (generally limited under low rainfall conditions), dust generation during dry and windy periods, and stormwater management design requirements.

#### 4.1.2. Topography, Geology and Soils

The topography of Tsumkwe is generally flat to gently undulating, typical of the Kalahari landscape. The area is dominated by deep Kalahari sands, interspersed with pans (clay-bottomed depressions) and fossil drainage lines. Geologically, the region forms part of the Kalahari Basin and is underlain by sedimentary deposits of the Kalahari Group, which overlie older basement rocks associated with the Damara Supergroup (Geological Survey of Namibia, 2003)

Kalahari sediments in the region typically consist of unconsolidated to semi-consolidated sands, calcrete, silcrete, and locally conglomeratic layers. The sandy soils are generally

classified as Arenosols, characterized by high permeability, low nutrient content, and limited water-holding capacity (FAO, 2006). The thickness of the Kalahari sand cover may range from several metres to over 30 metres in places. Pan areas tend to accumulate finer materials and secondary carbonate precipitates (calcrete), influencing localized soil chemistry and vegetation patterns (Council for Geoscience, 2008).

In relation to waste management, the high permeability of sandy soils presents potential risks for groundwater contamination if leachate is not properly controlled. An engineered containment measures are essential in landfill design within this geological setting.

#### 4.1.3. **Surface Water and Groundwater Resources**

Tsumkwe, Namibia, is primarily dependent on groundwater from the sandy aquifers of the Kalahari Basin, where pans play an important hydrological role as recharge/discharge zones. Surface water is scarce and only found in seasonal pans, ephemeral streams, and springs that are fed by this underground water, requiring careful management due to variable recharge and potential contamination issues like high salinity or fluoride. Water demand thus rises in parallel with ongoing population growth and development. In addition to posing danger to water scarcity, rising water demand can also lead to poor water quality, particularly in regions that rely on shallow groundwater bodies (Amutenya, 2016).

Tsumkwe is in the Kalahari sands, where water slowly percolates and forms enormous groundwater reserves that function as a sponge to supply water during dry spells. The many pans in the Tsumkwe region are important because they serve as locations where water enters the groundwater system (recharge) or exits it (discharge), affecting the local hydrology. Additionally, the amount of groundwater varies with rainfall, making the supply inconsistent at times (Amutenya, 2016).

In this arid area, true perennial surface water is uncommon; most water features are temporary, emerging following rainfall. This vast wetland area in northeastern Namibia is located between the Nhoma and Daneib drainage systems on a wide, level watershed on the eastern side of the Kalahari Basin. There are no significant rivers that flow out of the area, and drainage is severely limited by soil types and geology (Shigwedha, 2023).

#### 4.1.4. **Vegetation and Fauna**

Tsumkwe is located within the north-eastern Kalahari woodland and savanna ecosystem of Namibia. The vegetation in this area is predominantly classified as Kalahari woodland and shrub savanna, characterized by drought-adapted tree and shrub species interspersed with perennial and annual grasses. The deep Kalahari sands give rise to Arenosol soils, which are generally nutrient-poor but well-drained. These soil conditions favor plant species adapted to low fertility and periodic drought (Food and Agriculture Organization, 2006). Vegetation

density typically increases in and around pan systems and fossil drainage lines, where moisture retention is comparatively higher. Nevertheless, the ecosystem remains highly sensitive to disturbance due to slow natural regeneration rates under conditions of low and variable rainfall.

According to Hays and Hitchcock (n.d.), Tsumkwe settlement falls within the Nyae Nyae Community Forest, which was established in 2013. The Community Forest shares the same boundaries as the Nyae Nyae Conservancy and is defined under the Forest Act (No. 12 of 2001) and the Forest Amendment Act (No. 13 of 2005). The area is administered by the Ministry of Agriculture, Water and Forestry (MAWF).

At the proposed project site, vegetation identified includes several protected and ecologically significant tree species, namely *Combretum imberbe*, *Terminalia sericea*, *Acacia erioloba*, *Burkea africana*, *Philenoptera nelsii*, *Pterocarpus angolensis*, *Acacia reficiens*, and *Combretum collinum*. These species are characteristic of Kalahari woodland ecosystems and contribute to the ecological integrity and biodiversity value of the area.

It was further noted during the site assessment that the proponent had commenced clearing approximately one hectare of land and had erected a temporary shack intended for use by the contractor prior to the issuance of the Environmental Clearance Certificate (ECC). In response, a formal notice was issued instructing the proponent to cease all development activities pending the granting of the ECC (**Annexure B**).



Figure 7 Part of the Flora within the project area

Faunal diversity in the Tsumkwe area is notable, as the region forms part of the broader Kalahari wildlife range in north-eastern Tsumkwe. The area supports a wide variety of large and medium-sized mammals, including antelope species such as kudu, gemsbok (oryx), springbok, and impala, as well as predators including leopard, cheetah, brown hyena, and lion. Elephants move seasonally through parts of north-eastern Namibia, particularly within communal conservancies, and are known to use migration routes that pass through the proposed project area (MET, 2011). Evidence of elephant presence, including dung observed at the proposed landfill site, was recorded during the site visit, and community members confirmed that the area forms part of a migration corridor towards the Mangeti Dune area.

The area also supports giraffe and endangered species such as the African wild dog. During the public consultation process, Kwando Carnivore Project (referred to by stakeholders as Kwando Carnivores Trust) provided tracking data indicating that African Wild dogs have recently moved within the immediate footprint of the proposed landfill site. This confirms the ecological sensitivity of the area and its continued use by wide-ranging carnivores.

Avifaunal diversity is similarly significant. Seasonal pans, particularly Nyae Nyae Pan, transform into temporary wetlands after rainfall events and attract substantial numbers of waterbirds, including flamingos and wattled cranes. The broader semi-arid woodland habitat supports numerous bird, reptile, and small mammal species adapted to Kalahari conditions.

Community members further indicated that wildlife populations in the area are sensitive to increased human disturbance. It was shared during the public consultations that, impala that previously disappeared due to heightened human activity have been reintroduced only recently. There is concern that additional development and associated disturbance could once again displace these species. Stakeholders also raised concerns that the movement of elephants and other large mammals through the proposed site may increase risks of poaching and human-wildlife conflict.

The presence of free-ranging wildlife, intact woodland habitat, and ecologically important seasonal wetlands underscores the environmental sensitivity of the proposed landfill location. Poorly managed waste facilities may attract scavengers, rodents, and other nuisance species, potentially resulting in secondary environmental and public health impacts. Habitat fragmentation, vegetation clearing, and uncontrolled waste disposal may further disturb wildlife and degrade habitat integrity.

The proposed project should incorporate appropriate mitigation measures, including perimeter fencing to prevent wildlife access, controlled and regular waste covering to deter scavengers, minimal vegetation clearance, and ongoing monitoring of wildlife movement. These measures are necessary to reduce ecological impacts, limit human-wildlife conflict and maintain the integrity of the surrounding biophysical environment.

## 4.2. **The Social Environment**

### 4.2.1. **Settlement Pattern and Services**

Traditionally, the Nyae Nyae region (meaning "area of broken rocks") was home to seasonal San hunter-gatherers who lived a nomadic lifestyle moving from one place to the other. Today The Tsumkwe, which was also locally known as Nyae Nyae (meaning "area of broken rocks") was traditionally inhabited by San hunter-gatherers who practiced a seasonal, nomadic lifestyle, moving between resource areas in accordance with rainfall patterns and the availability of veld foods and game.

Today, Tsumkwe serves as the administrative centre of the settlement under the Otjozondjupa Regional Council. The settlement functions as a service hub for the surrounding rural communities and conservancies and accommodates a predominantly San population, who constitute the majority of residents in the area. Only a few hundred people reside within the town itself, a significantly larger population lives in surrounding villages within the broader Nyae Nyae area (Hays and Hitchcock, 2020).

Administratively, the district is divided into Tsumkwe East, which largely coincides with the Nyae Nyae Conservancy, and Tsumkwe West, which primarily comprises the N̄a Jaqna Conservancy. Although Tsumkwe functions as the main township and service centre, it remains socially and economically integrated with the surrounding conservancy areas.

The town includes a mix of formal and informal residential areas, informal trading outlets, small-scale businesses, and government administrative facilities. Basic public services available in Tsumkwe include government offices, a post office, NamWater boreholes, a clinic, and both primary and secondary schools. However, water supply infrastructure is reported to experience frequent operational challenges, including malfunctioning pumps, leakages, broken taps, and informal distribution systems. Inadequate maintenance and management of services have resulted in calls for improved infrastructure management, enhanced cost recovery mechanisms, and the introduction of community-led water conservation and sanitation solutions, such as dry toilet systems (Hays and Hitchcock, 2020).

Local economic activity remains limited but is supported by small-scale enterprises and community initiatives, including a craft centre, a community centre, trading shops, and guesthouses. These initiatives contribute to household income diversification in a context where formal employment opportunities are scarce (Hays and Hitchcock, 2020).

Tsumkwe plays a critical role as the administrative and service nucleus for the wider Nyae Nyae area, despite ongoing infrastructural and service delivery constraints.

#### 4.2.2. **Population and Livelihoods**

The population of the Tsumkwe Constituency is estimated at approximately 15,357 (Namibia Statistics Agency, 2023). However, the population residing within the Tsumkwe settlement itself is considerably lower than the constituency total, as a substantial proportion of residents live in dispersed rural villages across the district. Population growth in the constituency has been gradual but steady at 3.7% from 2011 to 2023, contributing to increasing demand for basic services and infrastructure, including water supply, sanitation, and waste management systems.

Livelihoods within the area are primarily based on a combination of livestock farming, subsistence activities, public sector employment, pensions, and informal trading. Livestock ownership plays an important socio-economic role, particularly in rural areas, while subsistence activities, such as harvesting of veld foods and limited small-scale crop production, supplement household food security. Formal employment opportunities are limited, with many households relying on government wages, social grants, and remittances as key sources of income. Overall, household income levels remain relatively low, reflecting high levels of economic vulnerability and dependence on state support mechanisms (NSA, 2023).

#### 4.2.3. **Land Use, Heritage and Sense of Place**

The land uses surrounding the proposed landfill site comprise villages, communal conservancies, and townlands. The site is located at a distance from dense residential areas and other sensitive land uses, thereby minimising the potential for land-use conflicts while remaining accessible to waste collection vehicles.

A strong sense of place characterises the broader Kalahari landscape, where traditional San hunter-gatherer practices coexist with contemporary conservation initiatives and agricultural resettlement schemes. Land use in the area reflects a complex integration of customary stewardship and formal governance structures. However, this integration presents challenges related to resource access, land tenure security, and balancing traditional livelihoods with development pressures. As noted by Hays and Hitchcock (2020), land is central to San identity, cultural continuity, and subsistence.

Historically, the San were semi-nomadic, moving seasonally across the Kalahari in response to the availability of water, vegetation, and wildlife. Despite significant areas of land now being classified as communal and administered by Land Boards and Traditional Authorities (TAs), many San communities have limited effective administrative authority over these lands. The Nyae Nyae Conservancy provides an example of evolving land governance, generating livelihood benefits, promoting conservation, and enabling community-based natural resource management. In addition, land has been allocated for small-scale agriculture and individual

resettlement; however, such initiatives face constraints including limited technical capacity, inadequate support services, and occasional land-use conflicts (Hays and Hitchcock, 2020).

The culture of the San, beliefs, and identity are intrinsically linked to land. Beyond its economic value, land represents heritage, spirituality, and social cohesion. The Ju/'hoansi San historically utilised the land around Tsumkwe, particularly the Bushman land area, as their n!ore (traditional hunting grounds), reinforcing deep-rooted connections to place. This interconnected relationship between land, nature, and culture underpins communal decision-making and sustains a distinct sense of place (Hays and Hitchcock, 2020).

The Otjozondjupa Region holds cultural significance for local communities. According to the National Heritage Council of Namibia (2018), no proclaimed heritage sites occur within the immediate footprint of the proposed landfill site. Nevertheless, the possibility of unmarked graves or archaeological materials cannot be excluded. Any chance finds encountered during construction or operation will be managed in accordance with the National Heritage Act (Act No. 27 of 2004).

#### **4.2.4. Traffic, Visual and Economic Environment**

The proposed landfill site is located in a remote area characterised by generally low traffic volumes and limited transport infrastructure. Access to the site is primarily via the gravel road connecting Tsumkwe to Grootfontein, which is long, uneven, and seasonally affected by rainfall. During the rainy season, sections of the road become slippery and difficult to navigate, however this is not a concern for waste collection vehicles. Existing traffic levels are low, and the operation of the landfill will introduce additional vehicle movements associated with waste transport. However, given the scale of the settlement and anticipated waste volumes, the increase in traffic is expected to be modest and unlikely to significantly alter current traffic patterns. Nevertheless, poor road conditions may increase operational costs and vehicle maintenance requirements.

From a visual perspective, the proposed landfill will be situated within a landscape that is largely natural and defined by the characteristic Kalahari environment. The surrounding area includes the Nyae Nyae Conservancy, which is recognised for their ecological value and tourism potential. Although the site is positioned away from major tourism nodes and dense settlement areas, the development of a landfill has the potential to introduce visual changes to the landscape, particularly if waste is not adequately managed. Appropriate design measures, perimeter fencing, windbreaks, and progressive covering of waste will be essential to minimise visual intrusion and prevent windblown litter, thereby maintaining the aesthetic quality of the surrounding environment.

Economically, the Tsumkwe settlement faces structural challenges, including high transportation costs, limited private sector activity, and reliance on government support. The

proposed landfill is not expected to be a major economic driver; however, it will provide short-term employment opportunities during the construction phase and a limited number of permanent operational positions. More importantly, the facility is anticipated to yield indirect socio-economic benefits. Improved waste management services can enhance environmental health conditions, reduce pollution risks, and contribute to a cleaner settlement environment. These improvements may positively influence community well-being and support local development objectives, including maintaining the area’s attractiveness for residents and potential visitors.

Improved waste management infrastructure strengthens service delivery capacity and demonstrates investment in essential public services. The economic contribution of the landfill will be modest in quantitative terms, in terms of environmental management, public health, and settlement aesthetics, which are considered significant within the context of a remote and infrastructure-constrained settlement such as Tsumkwe.

#### 4.3. Summary of key environmental sensitivities

Key sensitivities associated with the receiving environment include the high permeability of sandy soils, reliance on groundwater resources, proximity to communal land uses, and limited institutional capacity for waste management. These sensitivities inform the design, operation, and mitigation measures proposed for the Tsumkwe Landfill.

Table 2 Summary of key environmental sensitivities

Feature	Description	Sensitivity	Potential Impact
Climate	Semi-arid to arid climate; low annual rainfall ( $\pm 100-250$ mm), high evaporation, hot summers ( $>30^{\circ}\text{C}$ ), cool winters, intense seasonal storms.	Low rainfall limits natural leachate dilution; high winds increase dust and litter dispersion; intense storms may cause localized runoff and erosion.	Dust generation; windblown litter; stormwater runoff contamination; limited but episodic leachate generation.
Topography, Geology & Soils	Flat to gently undulating landscape, highly permeable sandy soils, presence of pans and calcrete layers.	High soil permeability increases risk of groundwater contamination; slow natural soil recovery.	Potential leachate infiltration into groundwater; soil degradation; erosion if vegetation is cleared.
Surface & Groundwater Resources	dependent on groundwater from Kalahari aquifers; limited surface water; pans function as recharge/discharge zones;	High reliance on shallow groundwater; variable recharge; vulnerability to contamination due to sandy substrates.	Groundwater contamination from leachate; reduced water quality; impacts on community water supply.
Vegetation	Kalahari woodland and shrub savanna within the Nyae Nyae area; presence	Ecologically sensitive woodland; protected species present; slow	Habitat loss from vegetation clearing;

	of protected tree species; slow regeneration rates under low rainfall.	recovery from disturbance.	biodiversity decline; visual landscape alteration.
Fauna & Wildlife Movement	Part of broader Kalahari wildlife range; presence of elephant migration routes, African wild dog movements, large carnivores, antelope, impala and seasonal waterbirds.	High ecological sensitivity; wildlife corridors intersect site; species sensitive to disturbance.	Habitat fragmentation; human, wildlife conflict; attraction of scavengers; disruption of migration routes.
Settlement Pattern & Services	Small administrative centre serving dispersed rural communities; limited infrastructure; water and sanitation challenges.	Limited institutional and infrastructure capacity; reliance on basic services.	Strain on capacity if landfill poorly managed; opportunity for improved waste services.
Population & Livelihoods	Predominantly San population; livelihoods based on, subsistence activities, pensions, informal trade; low-income levels.	High socio-economic vulnerability; dependence on natural resources.	Health risks if waste mismanaged; short-term employment opportunities; indirect public health benefits.
Land Use & Cultural Context	In a conservancy; land central to San cultural identity; no proclaimed heritage sites within footprint	cultural attachment to land; no potential to discover heritage resources.	Cultural disturbance; potential heritage impacts; need for chance-find procedures.
Traffic & Access	Remote location; access via gravel road; low traffic volumes; seasonal road constraints.	Poor road conditions; limited transport infrastructure.	Minor increase in traffic; increased maintenance costs; limited regional traffic disruption.
Visual Environment	Natural Kalahari landscape with ecological and tourism value; site located away from dense settlement.	High visual sensitivity in natural setting; potential tourism implications.	Visual intrusion; windblown litter; aesthetic degradation if not properly managed.
Institutional Capacity	Limited local waste management systems and infrastructure.	Limited technical and financial capacity for advanced waste management.	Risk of poor operational control; need for strong management and monitoring systems.

## 5. PUBLIC CONSULTATION

Public consultation is a fundamental component of the Environmental Assessment (EA) process and is intended to ensure that Interested and Affected Parties (I&APs) are informed, and provided with an opportunity to comment on the proposed developments that may affect them. In terms of the Environmental Impact Assessment Regulations (2012), public consultation is defined as a process through which potential I&APs are given an opportunity to comment on, or raise issues relevant to, a proposed activity (Regulation 1).

The public consultation process for the proposed Tsumkwe Settlement Landfill was conducted in accordance with section 21 of the EIA Regulations (2012). The process was designed to promote transparency, inclusivity, and meaningful engagement, and to ensure that stakeholder concerns and expectations were identified and considered during the environmental assessment.

### 5.1. Stakeholder Identification

A comprehensive stakeholder identification process was undertaken to ensure that all relevant I&APs were included. A stakeholder register was compiled and maintained throughout the EA process and is provided in **Annexure B**. Identified stakeholders included, but were not limited to:

- National Government Ministries,
- Regional and Local Authorities,
- State-Owned Enterprises and Utilities,
- Local Community Representatives,
- Private Sector Stakeholders, including local businesses and potential investors operating in or near the project area.

### 5.2. Stakeholder Notification

Formal notification of the proposed development was issued to all identified stakeholders. Email invitations containing a project description and details of the public consultation process were distributed to relevant institutions on 7 January 2026, inviting written comments and participation in the consultation process.

### 5.3. Public Notices

To ensure broad public awareness and compliance with regulatory requirements, public notices were placed in national newspapers with wide circulation, as follows:

- New Era newspaper on 7 and 21 January 2026; and
- Windhoek Observer newspaper on 7, 8, 14, and 15 January 2026.

These notices provided a summary of the proposed project, information on how to register as an Interested and Affected Party, and details on how comments could be submitted.

#### 5.4. **Site and Community Notice Boards**

In addition to newspaper advertisements, physical notices were placed at strategic and accessible locations within the project area to ensure that local community members were adequately informed such as:

- Site
- Tsumkwe Settlement Office
- Local shops
- Police Station; and
- Otjozondjupa Regional Council Head offices.



*Figure 8 Site Notices*

#### 5.5. **Background Information Document**

A Background Information Document (BID) was prepared to provide stakeholders with detailed and accessible information regarding the proposed Tsumkwe Landfill, including the project description, location, anticipated impacts, and the environmental assessment process. The BID was distributed to stakeholders and made available to interested parties upon request. A copy of the BID is included in **Annexure C**.

#### 5.6. **Public Meeting**

A public consultation meeting was held on 06 February 2026 at Tsumkwe Settlement Office. The purpose of the meeting was to present the proposed project, outline the findings of the environmental assessment, and provide an opportunity for stakeholders to raise questions, comments, and concerns.



Figure 9 Public meeting held at the Tsumkwe Community Hall on 06 February 2026

The meeting was attended by community members, local leadership, and representatives of relevant authorities. Participants actively engaged in discussions related to environmental protection, public health, land use compatibility, and operational management of the proposed landfill. Attendance registers, meeting minutes, and photographic records of the meeting are provided.

Issues and concerns raised during the public consultation process have been recorded in an Issues and Responses Register and have been considered in the impact assessment and the development of mitigation measures presented in subsequent chapters of this report.

#### 5.6.1. Summary of Issues Raised

The comments and concerns raised during the public consultation process have been documented in an Issues and Responses Trail (**Annexure B**). Table 5.1 provides a summary of the key issues raised during the consultation process.

Table 3 Summary of Issues Raised During the Tsumkwe Public Consultation meeting

Theme	Issue to be Considered in Assessment
Project Financing & Institutional Capacity	Confirmation of funding and ability of Otjozondjupa Regional Council to procure equipment and operationalise the landfill.
Operational Sustainability	Long-term sustainability of landfill maintenance, including staffing, monitoring, and compliance with the EMP.
Legal Compliance & Premature Site Clearing	Clearing of vegetation and site occupation prior to ECC issuance; need for regulatory enforcement.

Surface Water & Groundwater Management	Water accumulation around site due to pans; protection of shallow aquifers from contamination.
Protected Tree Species	Presence of protected species ( <i>Combretum imberbe</i> etc.) and need for avoidance/mitigation measures.
Wildlife Movement & Human-Wildlife Conflict	Elephant and other wildlife movement through the area; need for fencing and mitigation to prevent conflicts.
Existing Dumpsite Rehabilitation	Clean-up and rehabilitation of the current uncontrolled dumpsite.
Forestry Compliance	Management of costs and responsibilities for removal or protection of trees.
Land Use & Site Location Clarity	Confirmation of site location relative to main road and surrounding land uses.
Community Health & Safety	Comparison of risks from current uncontrolled dumpsite versus proposed controlled landfill; public health benefits.
Balancing Environmental & Social Priorities	Coexistence between humans, wildlife, and vegetation.
Stakeholder Engagement	Incorporation of concerns raised during meetings into the EIA and EMP.

Table 4 Summary of Issues submitted via email

Theme	Issue to be Considered in Assessment
Proximity to MAWLR/MEFT Breeding Facility	Landfill location next to sensitive animal breeding/quarantine station; assessment of land-use conflict.
Human Health & Safety	Risks to staff from odour, disease vectors, and windblown litter.
Wildlife Breeding & Habitat Integrity	Disturbance from noise, human presence, and habitat clearing affecting breeding programmes and habitat integrity.
Wildlife Movement Corridor	Disruption of elephant migration corridor toward Mangetti Dune; impacts on ecological connectivity and tourism.
Reintroduced Species	Habitat clearing may displace reintroduced common impala populations.
Endangered Species - African Wild Dog	Risk of disturbance to endangered <i>Lycaon pictus</i> ; potential population decline.
Biodiversity & Conservation Policy Alignment	Contradiction with MEFT mandate to stabilize/enhance wildlife populations.
Increased Human Activity & Poaching Risk	Greater human and vehicle movement may alter wildlife behaviour and increase poaching risks.
Cumulative Impacts	Combined effect of landfill development with conservation and tourism activities.
Alternative Site Assessment	Need to identify alternative landfill sites outside wildlife corridors and sensitive zones.
Vegetation Clearing & Rehabilitation	Clearing of trees without rehabilitation plans; risk to vegetation and habitat.
Waste Containment & Wildlife Attraction	Potential for landfill to attract scavengers, increasing human-wildlife conflict.

The feedback received has been incorporated into the environmental assessment and mitigation planning presented in subsequent chapters. All stakeholder comments, including those submitted in writing or during the public meeting, are recorded in **Annexure B**.

This chapter ensures compliance with EIA Regulations (2012), Section 21, and demonstrates that all interested and affected parties (I&APs) were given a fair opportunity to participate in the process.

## **6. IMPACT ASSESSMENT**

### **6.1. Methodology Employed for the Impact Assessment**

In accordance with the Environmental Impact Assessment (EIA) Regulations, (2012), the potential environmental and socio-economic impacts associated with the proposed Tsumkwe Landfill were systematically identified, evaluated, and ranked according to their significance. The Regulations require a description of the nature, extent, duration, intensity, probability, and significance, including cumulative effects, that may arise from the undertaking of a listed activity. The methodology comprised the following key steps:

#### **6.1.1 Impact Identification and Screening**

All potential impacts associated with planning, construction, and operation phases. Impacts for closure and post-closure phases of the landfill should be done with a separate study to identified and prepare an decommissioning and post closure mitigation measures during that period. Impacts falling outside the responsibility or control of the project proponent were excluded.

#### **6.1.2 Assessment Readiness**

Each identified impact was reviewed, and where uncertainty existed, conservative assumptions were applied, and additional monitoring requirements were recommended. The baseline environmental and socio-economic data were reviewed to identify impact, the availability, quality, and adequacy. Baseline information was limited or uncertainty existed, conservative assumptions were applied to ensure a precautionary approach. In such cases, additional monitoring and management measures were recommended to address data gaps and reduce uncertainty.

#### **6.1.3 Impact Characterisation**

Each impact was characterised based on a set of predefined criteria, including its nature, extent, duration, intensity, and probability of occurrence. The overall significance of each impact was determined and assigned a rating of low, medium, or high. Significance ratings were determined for both pre-mitigation and post-mitigation scenarios to evaluate the effectiveness of proposed mitigation measures.

In addition, a degree of confidence was assigned to each impact prediction, reflecting the reliability of available data and the level of professional judgement applied. This approach ensures that decision-making is informed by a clear understanding of potential risks and benefits, as well as the effectiveness of mitigation and management measures.

## 6.2. Criteria Used to Determine Significance

Table 5 Impact Assessment Criteria

Criterion	Definition
Nature	Type of effect on biophysical or socio-economic components (positive, negative, neutral).
Extent	Spatial scale of impact: site-specific, local (~15 km), regional (~100 km), national, or international.
Duration	Temporary, short-term (1-5 years), medium-term (5-10 years), long-term (>10 years), or permanent.
Intensity	Magnitude of impact: low, medium, or high.
Probability	Likelihood of occurrence: improbable, probable, highly probable, or definite.
Significance	Overall importance of the impact (low, medium, high).
Status	Positive or negative effect.
Degree of Confidence	Level of certainty in the assessment based on data quality and professional judgement.

Table 6 Significance Rating Definitions

Rating	Definition
Low	Negligible influence; impacts easily managed through standard controls.
Medium	Noticeable influence; requires mitigation and management measures.
High	Significant influence; may require design changes, intensive mitigation, or reconsideration of the activity.

## 6.3. Assessment of Impacts by Project Phase

The impacts associated with the Tsumkwe Landfill differ in nature and intensity depending on the project phase. Impacts are assessed separately for the construction phase and the operational phase. Closure and post-closure impacts are addressed in the EMP.

### 6.3.1. Planning and Design Phase Impacts

Impacts associated with the planning and design phase occur prior to physical construction activities and are primarily related to site selection, layout design, engineering specifications, and regulatory approvals. Although no on-site disturbance takes place during this phase, decisions made at this stage have long-term implications for environmental performance, operational efficiency, and community acceptance of the proposed development. Impacts during the planning and design phase are therefore largely strategic in nature.

Table 7 Planning and Design Phase Impact Assessment

Impact	Nature / Status	Extent	Duration	Intensity	Probability	Confidence	Significance (Pre-Mitigation)	Mitigation Measures	Significance (Post-Mitigation)
Inappropriate site selection affecting groundwater	Negative	Local	Long-term	High	Probable	High	High	avoid pans and recharge zones; incorporate engineered liner system and leachate management design;	Low
Impact on wildlife corridors (elephant and African wild dog movement)	Negative	Local to Regional	Long-term	High	Probable	Medium	High	micro-site to avoid corridors; incorporate wildlife-proof fencing; reduce the size from the proposed 30 ha to only 1 ha, which is sufficient for the development	Medium
Loss of protected tree species	Negative	Site-specific	Permanent	Medium	Probable	High	Medium	avoid large protected trees where possible; obtain forestry permits; implement offset planting	Low
Land use conflict with conservancy and breeding facilities	Negative	Local	Long-term	Medium	Probable	Medium	Medium	stakeholder engagement; conservancy management plans	Low
Improved waste management planning for Tsumkwe	Positive	Local	Long-term	Medium	Definite	High	Medium (Positive)	Incorporate best-practice landfill design standards; ensure institutional capacity planning	High (Positive)

### 6.3.2. Construction Phase Impact Assessment

Construction-phase impacts are generally short-term and site-specific but may be intense if not properly managed. These impacts arise mainly from site clearance, excavation, earthworks, access road construction, and vehicle movement.

Table 8 Construction Phase Impacts assessments

Impact	Nature / Status	Extent	Duration	Intensity	Probability	Confidence	Significance (Pre-Mitigation)	Mitigation Measures	Significance (Post-Mitigation)
Vegetation clearing and habitat loss	Negative	Site-specific	Permanent	Medium	Definite	High	Medium	Limit clearing footprint; demarcate work areas; rehabilitate disturbed areas; protect retained trees	Low
Soil disturbance and erosion	Negative	Site-specific	Short-term	Medium	Probable	High	Medium	Stormwater controls; avoid construction during heavy rains; progressive rehabilitation	Low
Disturbance to wildlife from noise and activity	Negative	Local	Short-term	Medium	Probable	Medium	Medium	Restrict working hours; prohibit hunting; environmental awareness training	Low
Dust generation from earthworks	Negative	Local	Short-term	Medium	Highly probable	High	Medium	Water suppression; speed control on access roads; PPE for workers	Low
Risk of groundwater contamination during excavation	Negative	Site-specific	Short-term	Low	Improbable	Medium	Low	No hazardous waste during construction; proper fuel storage and spill management	Low
Temporary employment opportunities	Positive	Local	Short-term	Low	Definite	High	Low (Positive)	Prioritise local labour recruitment especially for unskilled labor	Medium (Positive)

### 6.3.3. Operational Phase Impact Assessment

Operational impacts represent the most significant risks associated with landfill development and persist over the life of the facility. These impacts relate to waste deposition, leachate and gas generation, traffic movement, public health risks, and nuisance effects.

Table 9 Operational Phase Impact Assessment

Impact	Nature / Status	Extent	Duration	Intensity	Probability	Confidence	Significance (Pre-Mitigation)	Mitigation Measures	Significance (Post-Mitigation)
Groundwater contamination from leachate (highly permeable Kalahari sands)	Negative	Local	Long-term	High	Probable	Medium	High	Engineered liner; leachate collection; groundwater monitoring boreholes; waste compaction and covering	Medium to Low
Attraction of scavengers and wildlife	Negative	Local	Long-term	Medium	Highly probable	High	High	Perimeter wildlife-proof fencing; waste cover; controlled access; no open burning	Low
Disruption of wildlife movement (elephants, African wild dogs)	Negative	Local to Regional	Long-term	High	Probable	Medium	High	Secure fencing; avoid expansion into corridors; ongoing ecological monitoring, reduce project area from 30 ha to 2 ha	Medium
Dust and windblown litter	Negative	Local	Long-term	Medium	Highly probable	High	Medium	Windbreaks; daily covering; litter nets; routine site housekeeping	Low
Visual intrusion in natural Kalahari landscape	Negative	Local	Long-term	Medium	Probable	High	Medium	Berms; progressive rehabilitation; controlled cell development	Low
Increased traffic on gravel access roads	Negative	Local	Long-term	Low	Probable	High	Low	Vehicle speed limits; road maintenance coordination	Low
Public health improvement compared to	Positive	Local	Long-term	High	Definite	High	High (Positive)	Proper waste control; prohibition of open dumping; vector management	High (Positive)

uncontrolled dumpsite									
Employment (site operators and maintenance staff)	Positive	Local	Long-term	Low	Definite	High	Medium (Positive)	Local employment preference; training programmes	Medium (Positive)
Institutional capacity strain	Negative	Local	Long-term	Medium	Probable	Medium	Medium	Capacity building; budgeting for equipment and monitoring; EMP implementation	Low

#### 6.3.4. Closure and Post-Closure Phase

Closure and post-closure impacts associated with the Tsumkwe Landfill require a dedicated and detailed assessment that extends beyond the scope of the current construction and operational impact evaluation. Landfill closure presents long-term environmental risks, particularly in relation to groundwater contamination, settlement and stability of waste masses, continued leachate generation, gas management, rehabilitation success, and long-term monitoring requirements. Given the highly permeable Kalahari sandy soils, reliance on groundwater resources, and ecological sensitivity of the surrounding conservancy areas, a separate Closure and Post-Closure Management Plan should be prepared prior to decommissioning. This study should include detailed rehabilitation design, long-term groundwater monitoring programmes, financial provision for post-closure care (minimum 20-30 years), vegetation restoration strategies using indigenous species, and mechanisms to ensure institutional continuity and funding. Conducting a dedicated closure study will ensure regulatory compliance, reduce long-term environmental liability, and protect both ecological integrity and community health beyond the operational life of the landfill.

#### 6.4. Discussion of Key Impacts

##### 6.4.1. Planning and Design Phase

The planning and design phase presents several potentially significant long-term environmental risks if not properly addressed. The most critical concern relates to groundwater protection. The proposed site is located within the Kalahari Basin, characterised by highly permeable sandy soils with limited natural attenuation capacity. Given the reliance of the Tsumkwe community on groundwater resources, any inappropriate site design could pose a high risk of leachate migration into shallow aquifers. Stakeholders raised specific concerns regarding water accumulation near pans and the protection of recharge zones. Without engineered containment, the potential impact would be rated as high.

To harmonise this risk, the landfill must incorporate an engineered liner system, leachate collection and removal infrastructure, stormwater diversion berms. The final design should avoid proximity to pans and known recharge areas. Conservative design assumptions should be applied due to the ecological sensitivity of the area.

Another key issue raised during consultation relates to wildlife movement, particularly elephant migration routes and confirmed presence of African wild dogs, and re-introduction of the impala within the project footprint. The area falls within the Nyae Nyae conservancy landscape, which supports significant wildlife populations. Disruption of wildlife corridors could result in habitat fragmentation, increased human-wildlife conflict, and reputational impacts related to conservation commitments.

Mitigation during the design phase must therefore include micro-siting of infrastructure within the allocated footprint to avoid major wildlife paths, incorporation of wildlife-proof perimeter fencing, and formal engagement with conservancy representatives and other stakeholders.

Loss of protected tree species was also identified as a concern, especially following premature site clearing prior to ECC issuance. Protected species should be avoided where feasible, and any required removal must comply with forestry permitting procedures. Rehabilitation planning and offset planting using indigenous species should be incorporated into the design phase to maintain ecological integrity.

Overall, with appropriate design controls, most planning-phase impacts can be reduced from high or medium significance to low or moderate residual significance.

##### 6.4.2. Construction Phase

Construction impacts are generally short-term and site-specific but may be locally intense. The primary impacts include vegetation clearing, soil disturbance, dust generation, and disturbance to wildlife due to noise and human activity.

Vegetation removal will result in permanent habitat loss within the defined footprint. Given the slow regeneration rate of Kalahari woodland ecosystems under low rainfall conditions, this impact is initially of medium significance. However, limiting clearing strictly to the operational footprint, demarcating no-go areas, and implementing progressive rehabilitation of temporarily disturbed areas will substantially reduce long-term effects. It is therefore suggested that the project area be limited to only 1 ha instead of the proposed 30.62 ha, considering the waste generation rate of the settlement.

Dust generation during earthworks and vehicle movement is likely under the semi-arid climatic conditions, particularly during dry and windy periods. While temporary, this may affect nearby vegetation and workers. Mitigation measures such as water suppression, speed restrictions, and controlled stockpiling will reduce this impact to low significance.

Wildlife disturbance during construction is of particular concern due to the confirmed presence of elephants and African wild dogs. Construction activity may temporarily displace wildlife from the immediate area. To minimise this, working hours should be restricted to daylight periods, environmental awareness training should be provided to workers, hunting or harassment of wildlife must be strictly prohibited, and food waste must be properly managed to prevent attraction of animals.

Stakeholders also raised concern regarding regulatory compliance following early site clearing. Strict adherence to the conditions of the Environmental Clearance Certificate (ECC), appointment of an Environmental Control Officer (ECO), and implementation of the Environmental Management Plan (EMP) during construction will ensure improved governance and accountability.

Socio-economically, the construction phase generates short-term employment opportunities for local residents, a positive impact that contributes to local income generation in a context of high socio-economic vulnerability. The implementation of mitigation measures, construction-phase impacts are expected to reduce to low residual significance.

#### 6.4.3. **Operational Phase**

The operational phase presents the most significant long-term environmental and social risks, particularly in relation to groundwater contamination, wildlife interactions, and institutional capacity.

The potential for leachate generation and infiltration into groundwater remains the most critical environmental risk due to the highly permeable sandy soils. Although low rainfall limits leachate volumes, episodic high-intensity storm events could generate runoff and leachate pulses. Without engineered containment, the impact would be high. The installation of an engineered liner system, leachate drainage controls, stormwater separation systems, routine

compaction and daily waste covering, and a long-term groundwater monitoring programme are essential to reduce the residual risk to medium or low significance.

Wildlife attraction to waste is another major operational concern raised by stakeholders. Poorly managed landfills can attract scavengers, increase predator presence, and intensify human-wildlife conflict. In an area supporting elephants, carnivores, and reintroduced impala populations, this risk is significant. Mitigation requires installation of secure perimeter fencing, controlled access gates, prohibition of open burning, daily covering of waste, and immediate removal of hazardous materials. Continuous monitoring of wildlife interactions should be conducted in collaboration with conservancy structures.

Visual intrusion and windblown litter could degrade the natural Kalahari landscape and undermine tourism and conservation values. Progressive cell development, use of soil berms, windbreak fencing, and routine litter collection will reduce these impacts to low significance.

From a socio-economic perspective, the landfill will significantly improve public health conditions compared to the existing uncontrolled dumpsite. Stakeholders acknowledged the risks posed by the current disposal practices. Proper waste containment, vector control, and site management will reduce disease risks, improve settlement cleanliness, and contribute positively to environmental health. This represents a high positive impact.

Institutional capacity remains a concern. Limited technical and financial resources within the local authority may compromise long-term operational control. Capacity building, budgeting for equipment maintenance, clear allocation of responsibilities, and periodic environmental auditing are essential to ensure compliance and sustainability.

Overall, with full implementation of engineering controls, wildlife mitigation, and strong operational management, the operational impacts can be reduced to acceptable levels while delivering substantial public health benefits.

#### **6.5. Integrated Harmonisation of Environmental and Social Priorities**

The EIA findings indicate that the whole area of Tsumkwe settlement and the proposed landfill is located within an ecologically sensitive and socially vulnerable environment characterised by reliance on groundwater, active wildlife corridors, protected vegetation, and strong cultural attachment to land. The most significant risks relate to groundwater contamination and wildlife disturbance, while the most significant benefits relate to improved public health and formalised waste management. Harmonisation of environmental protection and community development requires:

- Strict adherence to engineered containment standards;
- Wildlife-sensitive fencing and monitoring particularly a boundary wall that can resist elephants;

- Minimal vegetation clearing and active rehabilitation;
- Transparent engagement with conservancy and community structures;
- Strong institutional management and monitoring systems; and
- Rehabilitation of the existing uncontrolled dumpsite.

Provided that these mitigation measures are fully implemented and monitored, the residual environmental impacts can be reduced to low or moderate levels, while the social and public health benefits remain significant and long-term. The development is therefore considered environmentally manageable, subject to strict compliance with the Environmental Management Plan and regulatory conditions. The impact assessment undertaken for the proposed Tsumkwe Landfill demonstrates that the project will result in a combination of short-term construction-related impacts and longer-term operational impacts. The assessment confirms that most negative impacts can be effectively avoided, minimised, or managed through appropriate design, operational controls, and implementation of the Environmental Management Plan (EMP). The key findings are summarised below by project phase.

## 7. RECOMMENDATIONS AND CONCLUSIONS

### 7.1. Conclusion

This Environmental Impact Assessment (EIA) evaluated the potential environmental and socio-economic impacts associated with the proposed Tsumkwe Landfill in the Otjozondjupa Region, Namibia. The assessment considered baseline conditions of the receiving environment, stakeholder concerns raised during the public consultation process, and the anticipated impacts during the planning, construction, and operational phases of the project.

The receiving environment is environmentally sensitive. The site is located within the Kalahari sands of north-eastern Namibia, characterised by highly permeable soils, reliance on groundwater resources, limited surface water availability, and ecologically significant woodland and wildlife systems associated with the Nyae Nyae area. The presence of protected tree species confirmed movement of elephants, and documented activity of endangered African wild dogs elevate the ecological sensitivity of the area. The socio-economic environment reflects high levels of vulnerability, limited institutional capacity, and strong cultural attachment to land among the predominantly San communities.

The impact assessment indicates that, prior to mitigation, several operational-phase impacts are of high significance. However, with the implementation of appropriate engineering controls, wildlife-sensitive design, effective operational management, and strict adherence to the Environmental Management Plan (EMP), these impacts can be reduced to low or moderate residual significance.

Importantly, the benefits of replacing the current uncontrolled dumpsite with a properly designed and managed landfill are substantial in terms of environmental health, groundwater protection (if engineered correctly), and community well-being.

### 7.2. Recommendations

Based on the findings of this assessment, and in recognition of the need to balance social development with environmental protection, it is acknowledged that the broader townland is characterised by relatively dense Kalahari woodland vegetation and active wildlife presence. The ecological sensitivity of the area, including documented wildlife movement and the presence of protected tree species, necessitates a cautious and carefully managed development approach.

At the same time, the proposed landfill is considered essential. The current waste disposal practices at the existing dumpsite are environmentally unsustainable and pose unacceptable risks to public health, groundwater quality, and the surrounding environment. Continued operation of an uncontrolled dumping area is not a viable long-term option for the Tsumkwe settlement.

To minimise ecological disturbance while still addressing urgent waste management needs, it is recommended that the originally proposed project footprint of approximately 30.62 hectares be reduced to the approximately 2-hectare area that has already been cleared. Limiting the operational footprint to this smaller, defined area will significantly reduce vegetation loss, habitat fragmentation, and potential disruption of wildlife movement, while still allowing for the development of a properly engineered and managed landfill facility.

Subject to this reduced footprint, and provided that all recommended mitigation measures, engineering controls, wildlife protection measures, and monitoring requirements are fully implemented and strictly enforced, the proposed development is considered environmentally acceptable and manageable. With appropriate design, operational discipline, and institutional oversight, the landfill can provide critical waste management services while maintaining the ecological integrity of the surrounding environment.

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