



MINISTRY OF MINERAL RESOURCES, GREEN TECHNOLOGY AND ENERGY SECURITY

KASANE AND KAZUNGULA BOTSWANA

INTEGRATED WASTE MANAGEMENT PLAN



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Synopsis

This report outlines the Integrated Waste Management Plan (IWMP) for Kasane & Kazungula.

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Technical Definitions

Aquifer is a water bearing formation capable of supplying a sufficient yield for a community-based potable water source.

Cell is a volume of waste generally placed during one working day and covered on all horizontal surfaces by cover soil.

Clinical waste is any waste generated by hospitals, clinics, nursing homes, doctor's offices, medical laboratories, research facilities and veterinarians, which are infectious or potentially infectious;

Composting is the controlled aerobic biological decomposition of organic matter, such as food scraps and plant matter, into humus, a soil-like material. Aerobic is the decomposition process in the presence of oxygen.

Licensed landfill is a solid waste management facility used for the disposal of non-hazardous domestic waste and non-infectious medical waste, which employs compaction of wastes, covering of waste with soil cover material, and the management of leachate, all in such a manner as not to harm human health and minimize negative impacts to the environment.

Daily cover is a daily application and compaction of approximately 150 millimetres of soil intended to control blowing litter, odours, flies, rats and fires, intended for an exposure of less than one week.

Design Drawings are drawings prepared by the landfill designer and include dimensions, specifications and other technical data regarding the construction of the landfill.

Domestic solid waste (General Waste) is solid waste generated by single or multifamily residential dwellings, and solid waste of a non-hazardous nature, generated by wholesale, retail, institutional or service establishments such as office buildings, stores, markets, restaurants, theatres, hotels, warehouses, industrial operations and manufacturing processes.

Final Cover is an application and compaction of soil on the landfill after it has reached its designed elevation. The final cover soil shall be relatively impermeable and have a thickness of approximately 500 millimetres.

Groundwater is all waters flowing or existing under the ground surface.

Hazardous waste is any waste, which by reason of chemical reactivity, or toxic, explosive, corrosive or other characteristics causes danger or is likely to cause danger to human health or the environment, whether alone or in combination with other wastes. Hazardous waste is categorized in four hazard ratings with 1 being the most hazardous and 4 being the least hazardous.

Incineration is the controlled combustion of solid waste employing closed combustion chambers, controlled combustion air, temperature monitoring and control to insure complete combustion of organic matter with a minimum of undesirable air emissions and wastewater discharges.

Intermediate cover is an application and compaction of cover having the same functions as daily cover but applied at a thickness of 300 millimetres, intended to be exposed for a period of one week to one year.

Landfill Classification is a system under the Guidelines For The Disposal of Waste By Landfill Botswana First Addition 1997 for classifying landfill according to the type and size.

Landfill gas is the gaseous by-product of organic decomposition of landfilled waste. Landfill gas contains significant concentrations of methane gas, which is explosive at concentrations exceeding 5 percent.

Leachate is the liquid by-product of organic decomposition of landfilled waste or any liquid that comes in contact with solid waste in a sanitary landfill.

Lift is a series of one or more landfill cells forming a section of landfilled waste that extends horizontally across the landfill.

Operating Plan consists of drawings, descriptions and other documents regarding the operation of the landfill, placement of waste, building daily cells and lifts, leachate management, and all other functions related to the operation of the landfill.

Operator is the operator of an item of equipment or a vehicle associated with waste management.

Owner is the person or organisation that owns the property and/or facilities that constitute the landfill

Perimeter drains are open ditches surrounding the landfill installed to prevent surface water from entering the landfill.

Recycling is the sorting, processing, and transportation of solid waste materials, products or containers for the purpose of remanufacture or reuse.

Scavenging is the unauthorised separation of solid waste for recyclable materials and food for human consumption.

Solid Waste is waste of a solid nature generated by a person, business or industry.

Solid Waste Management facility is any facility used for the transportation, processing or disposal of solid waste, and includes transfer stations, recycling facilities, composting facilities, waste incinerators, and sanitary landfills.

Sorting is the authorised separation of solid waste materials for the purpose of recycling or disposal, either at the source of generation or at a solid waste management facility.

Special waste is a non-hazardous waste, which due to its nature requires special or separate handling at a sanitary landfill. Special wastes include but are not limited to tires, asbestos, demolition waste, industrial sludges of a non-hazardous nature, abattoir wastes and petroleum waste oil.

Surface water is all water in or coming from a water source, which is found on the surface of the ground, excluding water under the surface of the ground.

Transfer Station is a facility that receives solid waste from collection vehicles and reloads that waste into larger vehicles for transfer to a disposal or processing facility.

Toolbox talk is an informal group discussion that focuses on safety issues. These talks can be used at regular intervals to promote a safety culture as well as to facilitate health and safety discussions for on the job activities.

Vectors are birds, insects, and rodents capable of carrying disease-causing bacteria, viruses or fungi from one host to another.

Water Balance is a method for determining the potential for significant leachate generation, which includes climatic conditions (rainfall and evaporation) and site condition.

Working area is the area of the landfill where waste is unloaded, compacted and covered. It generally includes adequate space for several trucks to unload at the same time, for waste compaction and storage of cover soil.

1. INTRODUCTION

As a requirement of Botswana's Strategy for Waste Management 1998¹, all District and Local Authorities (LA) are obliged to compile Waste Management Plans. The Department of Energy (DOE) with the assistance of the United Nations Development Plan (UNDP), appointed a suitability qualified consultancy to compile an IWMP for Kasane and Kazungula in the Chobe District.

This document represents the first Integrated Waste Management Plan (IWMP) for Kasane and Kazungula. This document must be updated from time to time and as such remains **a live document** that remains relevant along with changes in Legislation, Waste Management Policies or significant increases in other factors such as economic or population growth. The IWMP not only addresses posts for personnel but also individuals to illustrate the specific requirements at the time of writing. Therefore, as changes occur the plan must be adjusted and remain relevant.

Botswana's Strategy for Waste Management² requires:

- Preservation, protection and improvement of the quality of the environment,
- Contribution towards the protection of human health,
- Ensuring prudent and rational utilisation of the natural resources.

To achieve these goals the strategy promotes:

- Minimising and reducing wastes in industry, commerce and private households,
- Maximising environmentally sound waste reuse and recycling, and
- Promoting environmentally sound waste collection, treatment, and disposal.

The guidelines for the drawing up of such waste management plans are addressed in the Waste Management Act 1998 Part IV. These requirements include *inter alia* the following information:

- i. Waste Quantities and Characterisation,
- ii. Waste disposal and treatment sites,
- iii. Personnel, equipment and other materials required for operating these sites,
- iv. methods by which, in a given period, the local authority intends to manage waste,
- v. Estimated costs of methods of waste management mentioned in the plan and how these may be recovered.

The process of developing the IWMP consisted of two phases. During the first phase an assessment of the current status of waste collection systems and existing disposal sites, service delivery capacity and a needs analysis for each of these aspects were done.

The second phase was the compilation of the IWMP. The Objectives and Goals identified are included in this phase, with alternatives for obtaining these being considered and evaluated on a high level thereafter. Based on the preferred options selected for implementation a programme was developed and cost estimates compiled to facilitate inclusion of the plan into the District Development Plan (DDP).

¹ Botswana Strategy for Waste Management 1998, Government of Botswana

² Botswana's strategy for Waste Management First Edition, 1998

2. Background

Kasane and Kazungula Area fall within the Chobe District in the North West District Council of Botswana. The Chobe District is situated in the north-eastern corner of the country and comprised 22,559 km².

Kasane and Kazungula shares borders with Zimbabwe in the east and the Namibian Caprivi Strip in the north. Zambia is located to the north, across the Zambezi River. In the west the District borders the Ngamiland District, and in the south, the Ngamiland and Central Districts. Kasane lies some 15km upstream of the confluence of the Chobe and Zambezi Rivers. Kasane is an important tourist destination and the placement of the landfill is such that it is one of the first things a visitor sees when traveling to Kasane. Waste management as a whole is also not currently at levels that are in line with local and international standards.

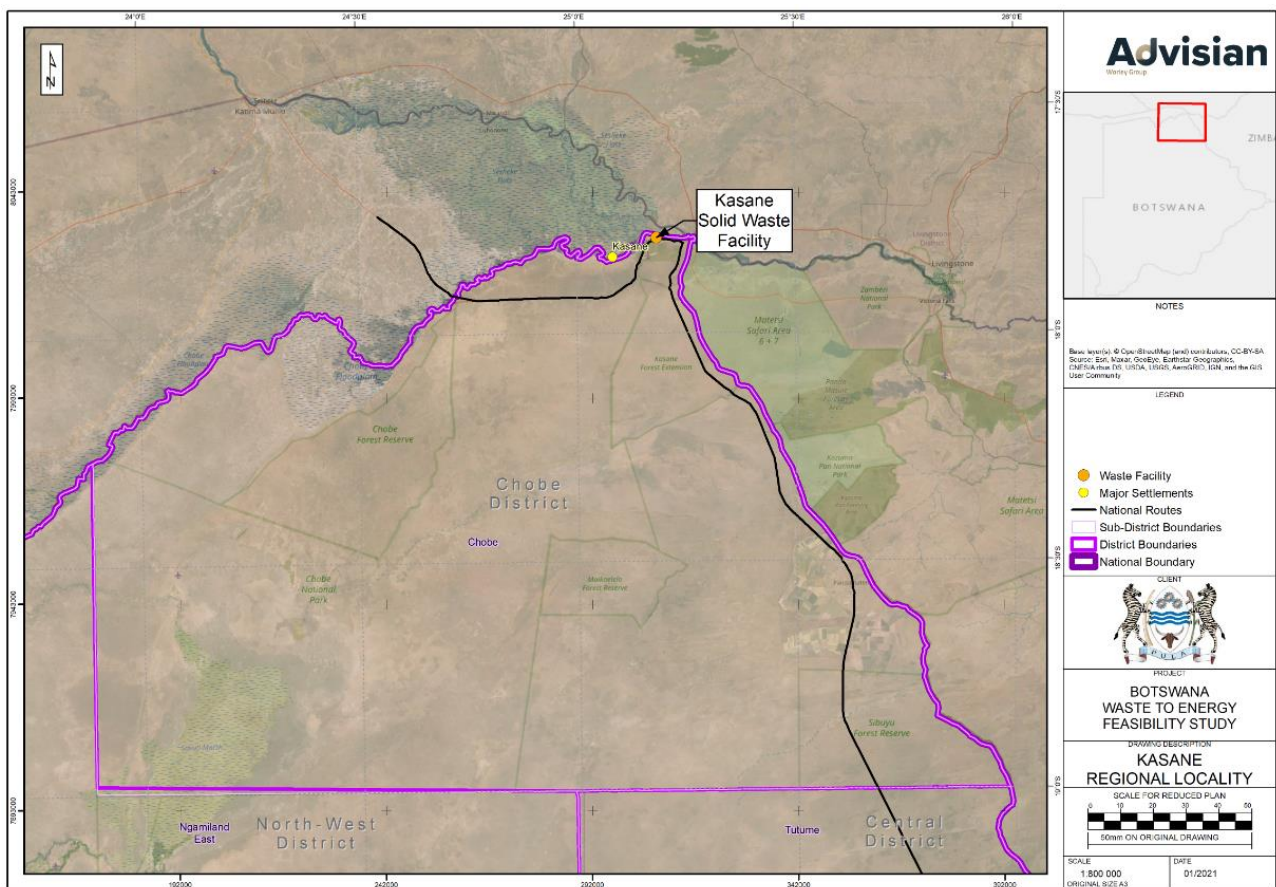


Figure 1: Location of Kasane

2.1 Geology and Hydrogeology

2.1.1 Local Geology³

The local geology is comprised of the Karoo Supergroup rocks. The Kalahari Basin is amongst the several contemporaneous basins in southern Africa which covers an extensive area in Botswana. The topmost geologic unit in the Kalahari Basin is the basalt of the Stormberg Lava Group. The eastern part of the Kalahari basin, the Stormberg Lava Group is underlain by the sandstone of Ntane Formation which in turn overlies the Mosolotsane Formation which is essentially made up of arenaceous sediments of fluvial origin. Below the Mosolotsane Formation is the Tlhabala Formation which conformably overlies the Tlapana Formation. The Tlapana Formation is comprised of mudstones, carbonaceous shales and coal seams. It overlies the Mea

³ Hydrogeochemistry Of the Kasane Thermal Spring, Botswana, B Mukwati, 2017

arkose Formation which is generally composed of pebbly sandstones and conglomerates (Modie & Le Herisse, 2009).

The adjacent Mid-Zambezi basin contains a thick basaltic rock at the top which belong to the Batoka Formation. The basalt is underlain by the Forest Sandstone Formation comparable to the Ntane Formation. Below the Forest Sandstone occurs the pebbly arkose and fine red marly sandstone with ripple marked flagstone at the bottom. This unit is a correlative of the Mosolotsane Formation (Johnson et al., 1996). It is important to note that for the information from the study used here, Kasane has no lithostratigraphic data from the area to confirm the stratigraphic column of the Karoo sequence in the area since there are no boreholes drilled in the area or in the vicinity of the area in Botswana.

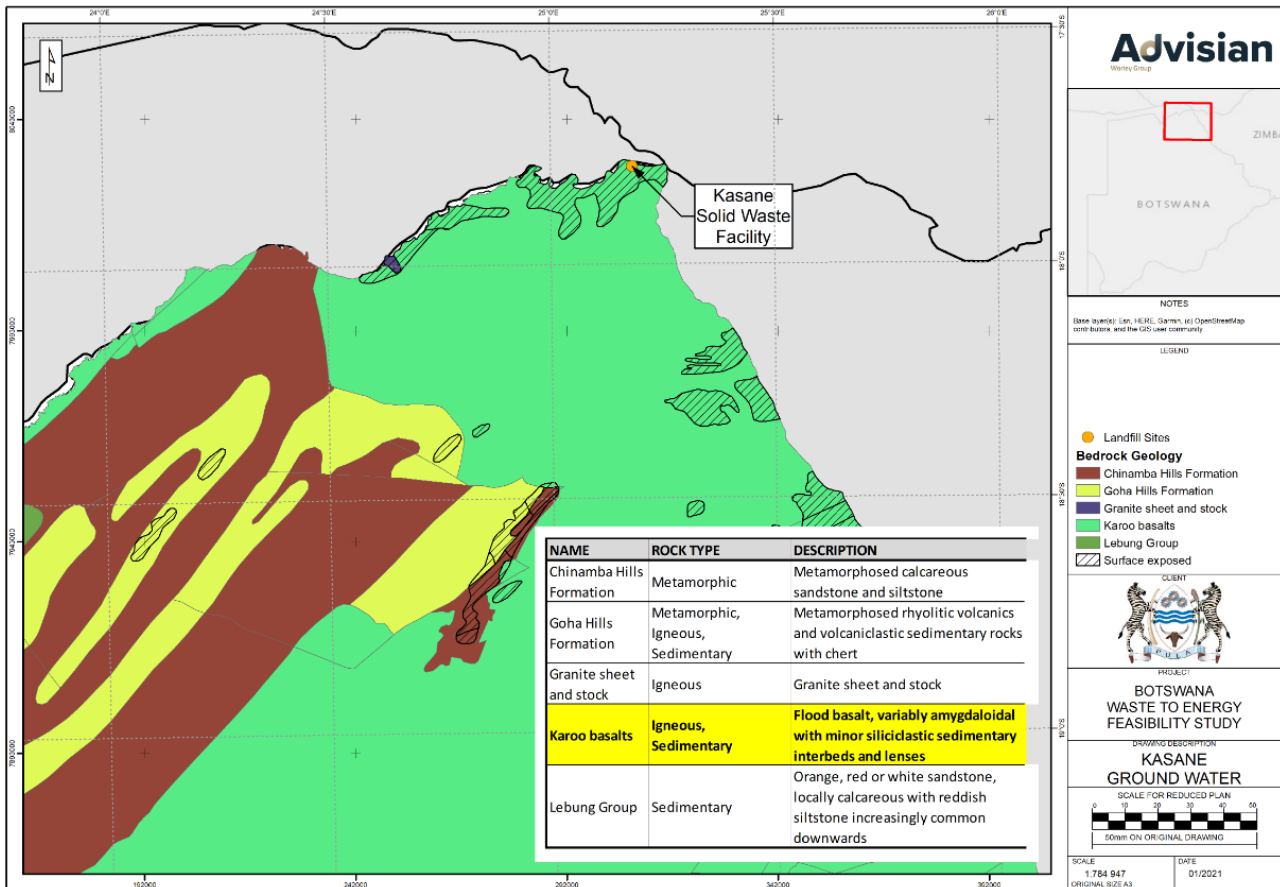


Figure 2: Regional Geology

2.1.2 Hydrogeology

The main groundwater resources are likely to be found in the Kalahari Group sediments. These aquifers are generally unconsolidated aeolian and fluvial sands. Recharge occurs predominantly by direct percolation from the surface and from the existing ephemeral water sources. Potentially larger water resources may also exist below Kalahari Group sediments in the basalt and potentially in the Karoo sandstones. Water from the Chobe river is used for the two towns.

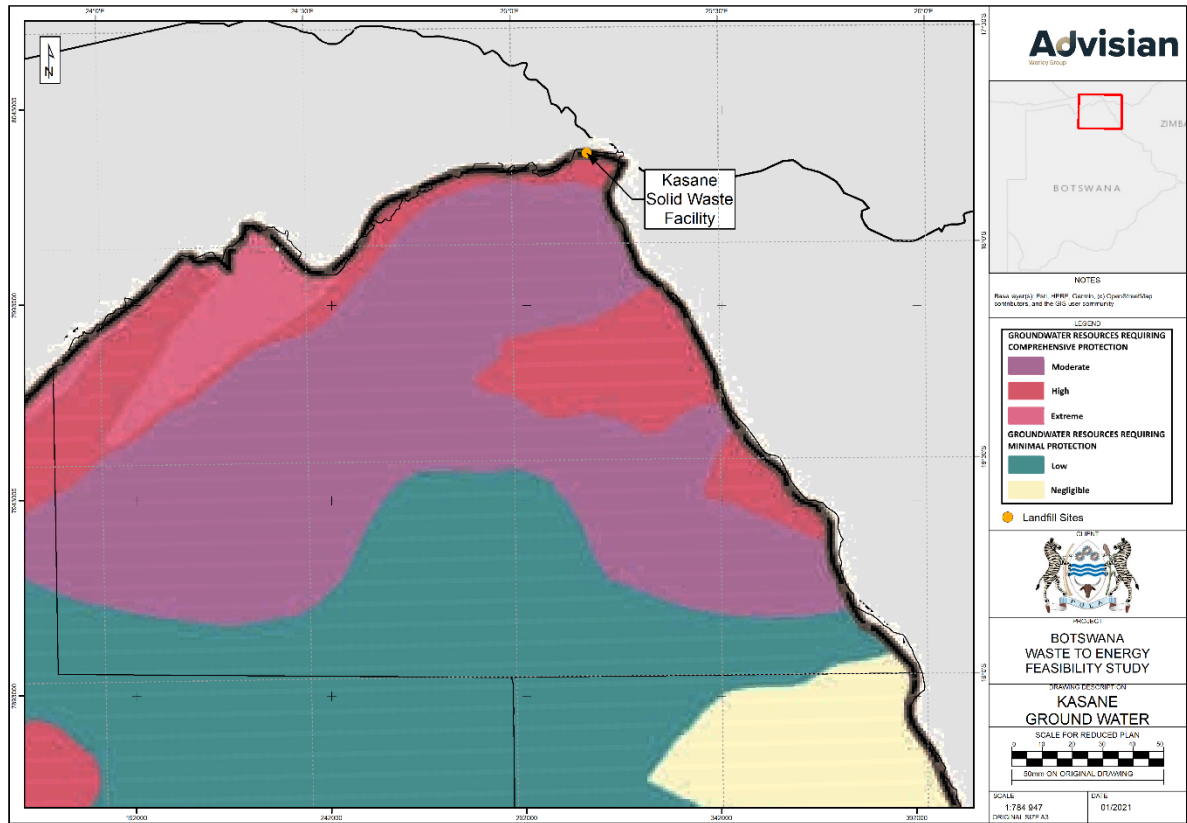


Figure 3: Groundwater Vulnerability Map

As depicted in Figure 3 Kasane and Kazungula, and specifically the landfill are located in an area where the groundwater is highly vulnerable, and the resource should be comprehensively protected.

2.2 Demographics

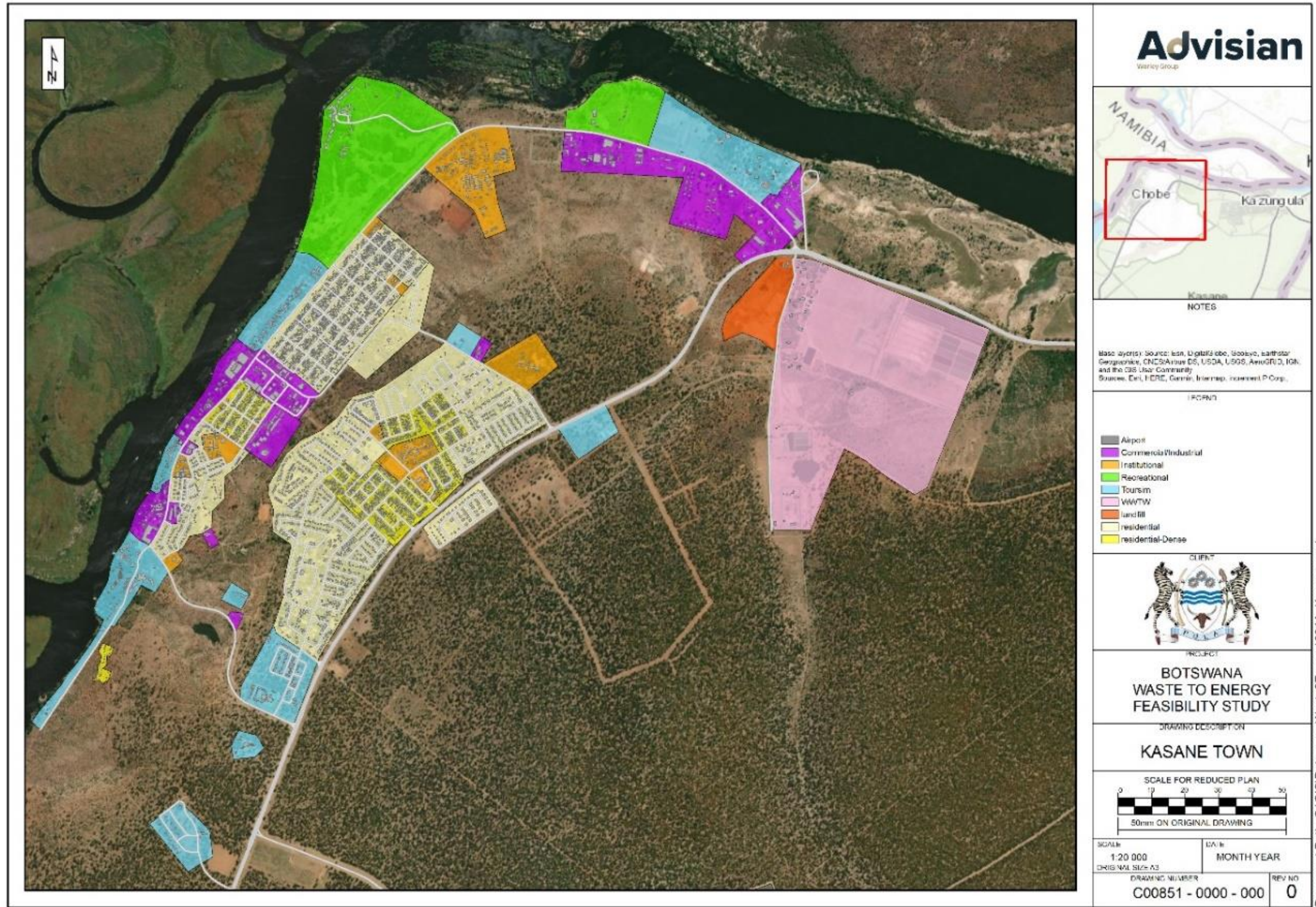
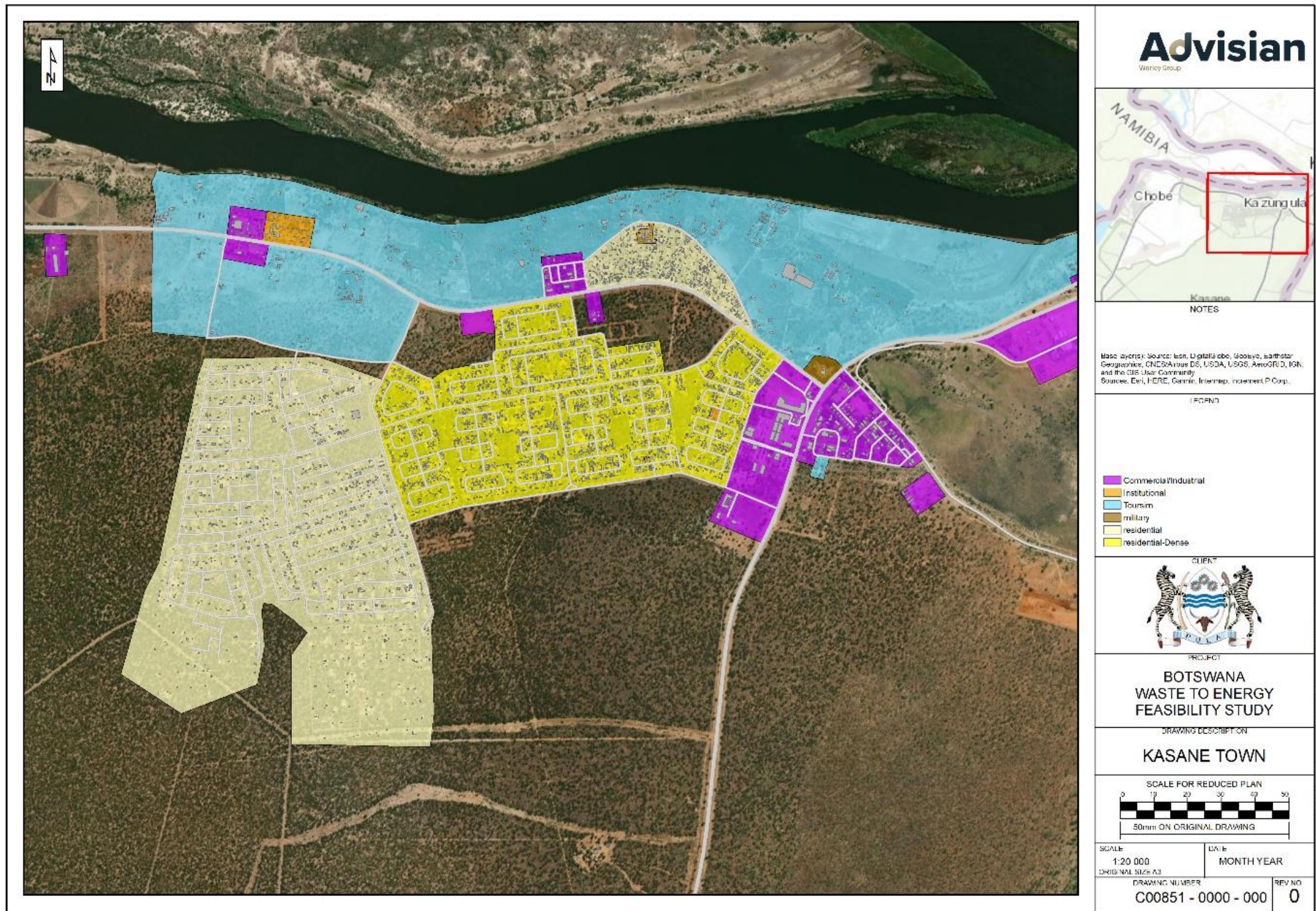


Figure 4: Kasane Land use Layout



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Figure 5: Kazungula Land use Layout



2.2.1 Population

The amount of waste generated in particular location is guided by the population

2.2.1.1 Population Growth Rate

Table 1 shows the population from the 2011 Census⁴ for Kasane and Kazungula.

Table 1: 2011 Census Population for Kasane and Kazungula

Location	Male Population 2011	Female Population 2011	Total Population 2011
Kasane	4,437	4,571	9,008
Associated Localities	172	64	236
SUB TOTAL	4,609	4,635	9,244
Kazungula	2,039	2,094	4,133
Associated Localities	128	59	187
SUB TOTAL	2,167	2,153	4,320
TOTAL	6,776	6,788	13,564

According to Statistics Botswana⁵ the population growth rate for Botswana will decrease from 2.03% in 2011 to 1.31% in 2026. Using the growth rate of 1.2% as projected by Stats Botswana for Chobe in the aforementioned document the population of Kasane and Kazungula is shown in . Table 2. To calculate the population in 2040 the same growth rate was used.

Table 2: Population Projection 2020 and 2040

Location	Total Population 2020	Total Population 2040
Kasane	10035	11180
Associated Localities	263	293
SUB TOTAL	10298	11473
Kazungula	5157	8435
Associated Localities	233	382
SUB TOTAL	5391	8817
TOTAL	15689	20290

2.2.1.2 Income Groups

Although levels of household income are not available, according to Statistics Botswana Poverty statistics Brief⁶, the percentage of people that live in poverty* is 19.3% for the Chobe District. Based on the figures in Table 2 from the 2011 Census this equates to 3,267 people in Kasane and Kazungula.

⁴ 2011 Population and Housing Census, Population of Towns, Villages and Associated Localities, Statistics Botswana Jun 2012

⁵ Botswana Population Projections 2011 – 2026, Statistics Botswana Nov 2015

⁶ Botswana, Multi-Topic Household Survey, Poverty Stats Brief 2015/16, Statistics Botswana Jan 2018

* Poverty incidence is determined by computing the Poverty Datum Line (PDL) based on the cost of a basket of goods and services assessed to be necessary to meet basic needs of household members. This is based on the basic requirements for food, clothing, personal items, household goods & services and shelter. The cost of the basket is then compared with the observed total consumption for the household. The observed total consumption of the household is determined by adding up the total Consumption Expenditure, Aid, Wages in-kind, Gifts Received, School Meals and Unearned Income in-kind. When the household's PDL is higher than its observed total consumption, the household is defined as poor. This means that all its household members are living below the PDL

During the Public Participation Process residents of Kasane and Kazungula that participated gave the following information regarding household income.

i. Kasane

Out of 93 households 59 had a household income of between 0 and BWP 5,000 per months, 8 had an income of between BWP 5,000 and BWP 15,000 and none above BWP 15,000.

ii. Kazungula

Out of 81 households 56 had a household income of between 0 and BWP 5,000 per months, 4 had an income of between BWP 5,000 and BWP 15,000 and none above BWP 15,000.

2.2.1.2.1 Employment and Vulnerability

The households questioned in both Kasane and Kazungula have a high employment rate.

Typically, people work for the local authorities, farming, the hospitality industry and local businesses. Many listed themselves as Self-Employed but did not give any additional information.

Of the households that answered the question, in Kasane 24 households indicated that there was a single breadwinner and 24 that there was a single breadwinner in a female headed household.

Of the households that answered the question, in Kazungula 26 households indicated that there was a single breadwinner and 19 that there was a single breadwinner in a female headed household.

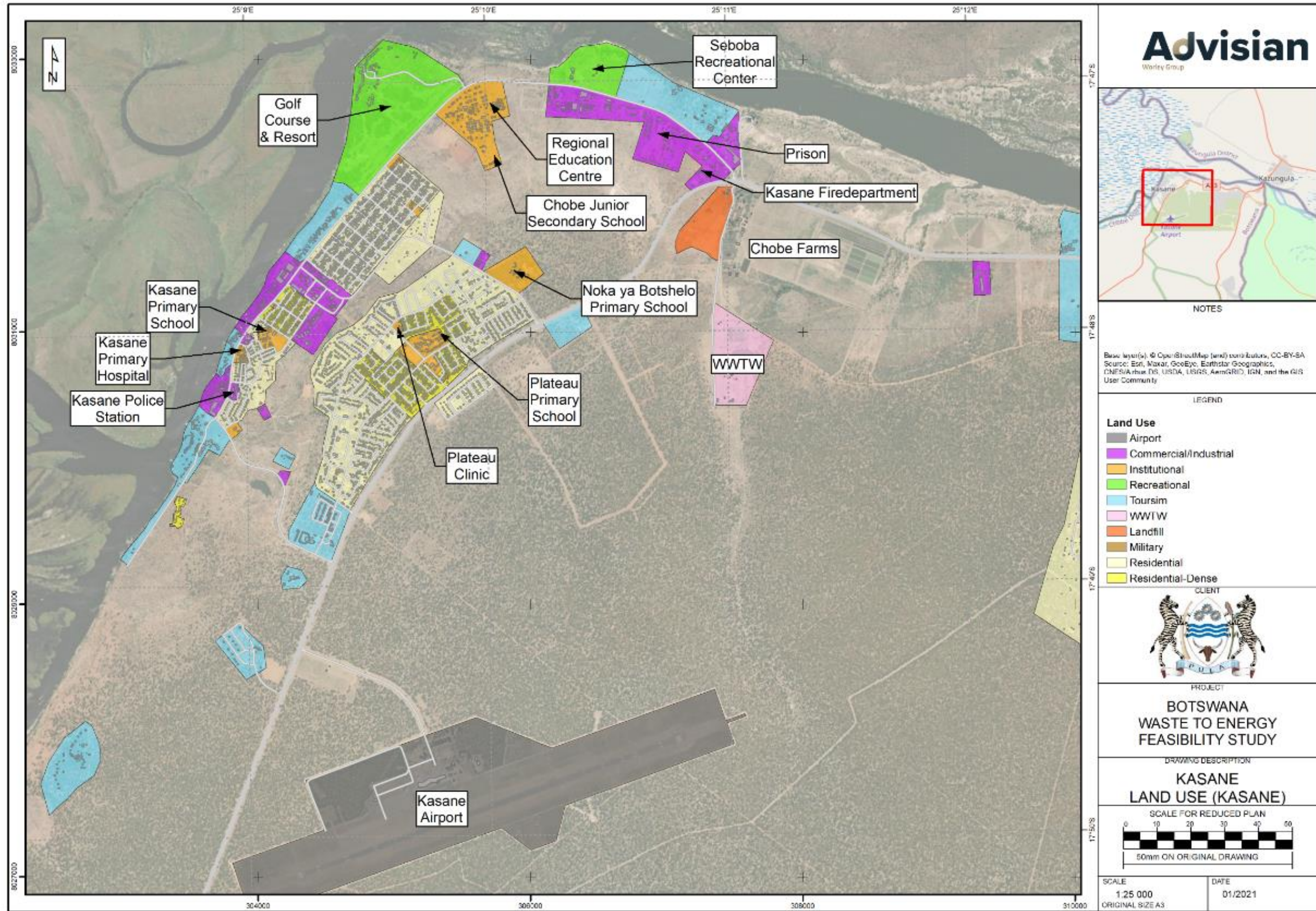
2.3 Land-Use

2.3.1 Kasane

Kasane consists mostly of residential areas with commercial sites such as shopping areas and very small light industrial areas. The area has various institutions including schools and a regional Education centre, a Golf course, a Recreational centre, Police station, Fire department, Churches, Clinics and a Hospital etc.

A number of Central Government Departments have district offices in Kasane including Department of Wildlife and National Parks, the Department of Water Affairs, the Department of Forestry and Range Resources, Department of Tourism and the Kavango Zambezi Transfrontier Conservation Area also has an office in Kasane. There is an airport in Kasane with regular weekly flights from Gaborone, mostly for tourists.

Kasane area has many guest houses and lodges that cater for the tourists that visit the area.



2.3.1.1 Kazungula

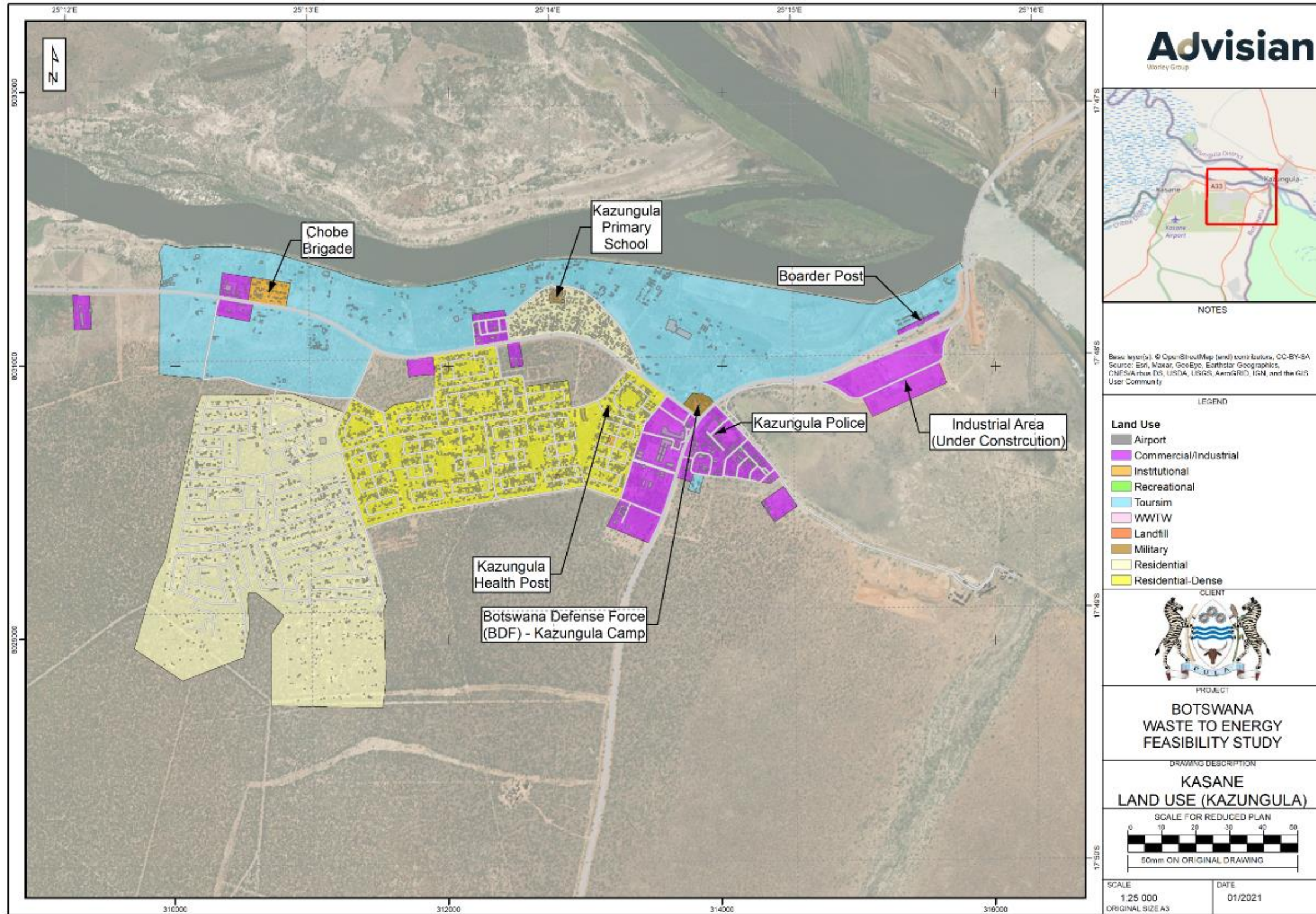


Figure 7: Kazungula Land Use Plan

2.4 Transport Infrastructure

The A33 regional road runs through both Kasane and Kazungula and also runs past the airport to the West. The road also gives access to the border crossing into Zambia to the east.

The roads in Kasane are mostly tarred roads that provide access to industrial and commercial premises and housing, there are houses however that have non tarred access roads.

The access roads to Kazungula residents are mainly not tarred but access roads to institutions and commercial and industrial areas are tarred.

The landfill is located on the corner of the A33 and President Avenue, the main road into Kasane.

The construction of the new bridge across the Zambezi river will be operational in 2021 and it is expected that traffic, including transport trucks will increase accordingly.

Both Lesoma and Pandamatenga have asphalt surfaced roads that lead to the A 33 regional route to the South of Kasane.

There is an asphalt surfaced road that turns off the A33 at Ngoma bridge that runs through Mabele and Kavimba up to Katchikau to the South West of Ngoma bridge. Access to Satau and Parakarungu are along a non surfaces road that leads from Katchikau.

The distances from the villages where waste is collected and transported to Kasane landfill are listed in Table 11

3. LEGISLATIVE FRAMEWORK

Waste management in Kasane and Kazungula falls within the national landscape of waste management in the country and therefore it is important to understand the legislation and strategies with regard to waste management as a whole. The following is a short summary of all the relevant legislation pertaining to waste management.

3.1 National Policies and Legislation

3.1.1 Botswana Strategy for Waste Management 1998

The Botswana Strategy for Waste Management 1998⁷ is intended to be proactive and incorporate various principles which make its implementation both feasible and achievable. The fundamental principles embodied in the strategy include the *Principle of Prevention*, the basis of which is to minimise environmental pollution by introducing appropriate management measures before damage occurs; the *Polluter pays Principle* which allocates the costs of preventing, eliminating or compensating for damage to the environment to the party responsible for such damage; and the *Principle of Co-operation* which seeks to foster teamwork and an ethic of co-operation among all social groups in the prevention and resolution of negative impacts on people and the environment. In addition, the strategy has adopted the internationally acceptable *Waste Management Hierarchy* predicated on Waste Re-duction, Reuse and Recycling. This strategy calls, for. technology initiatives in keeping with Botswana's economic ability to transform waste into useful by products, or effective attenuation of hazardous forms of waste before disposal.

The objectives, therefore, of this strategy are numerous but the most important include the following:

- i. Minimising and reducing wastes in industry, commerce and private households
- ii. Maximising environmentally sound waste reuse and recycling
- iii. Promoting environmentally sound waste collection, treatment, and disposal.

3.1.2 Waste Management Act 1998

The waste management Act was developed to provide for the establishment of the Department of Sanitation and Waste Management; to make provision for the planning, facilitation and implementation of advanced systems for regulating the management of controlled waste in order to prevent harm to human, animal and plant life; to minimise pollution of the environment, to conserve natural resources; to cause the provisions of the Basel Convention to apply in regulating the trans-boundary movement of hazardous wastes and their disposal; and for matters incidental to and connected to the foregoing.

3.1.3 Guidelines for the Disposal of Waste by Landfill 1997

The guidelines provide applicable waste management standards or specifications that must be met, as well as providing a point of departure against which environmentally acceptable waste disposal practices can be assessed. The objectives of setting Minimum Requirements are to:

- i. Prevent water pollution and to ensure sustained fitness for use of South Africa's water resources.
- ii. Attain and maintain minimum waste management standards in order to protect human health and the environment from the possible harmful effects caused by the handling, treatment, storage and disposal of waste.
- iii. Effectively administer and provide a systematic and nationally uniform approach to the waste disposal process.

⁷ Botswana Strategy for Waste Management, 1998

- iv. Endeavour to make Botswana waste management practices internationally acceptable.

Before a waste disposal site permit is issued, adherence to the Minimum Requirement conditions will be required from the permit applicant. The Minimum Requirements promote the hierarchical approach to waste management, as well as a holistic approach to the environment

3.1.4 Atmospheric Pollution (Prevention)

The Act provides for the prevention of the pollution of the atmosphere by the carrying on of industrial processes and for matters incidental to these processes. The law prevents any person from carrying on in or on any premises, industrial processes capable of causing or involving the emission into the atmosphere of objectionable matter unless he/she holds a registration certificate authorising him/her to do so.

3.1.5 Environmental Impact Assessment Act⁸

The Act provides for environmental impact assessment to be used to assess the potential effects of planned developmental activities; to determine and to provide mitigation measures for effects of such activities as may have a significant adverse impact on the environment; to put in place a monitoring process and evaluation of the environmental impacts of implemented activities and to provide for matters incidental to the foregoing.

3.2 Local Policies, Legislation and Waste Management Practices

3.2.1 Existing Waste Management Studies and Reports

3.2.1.1 Kasane - Kazungula Redevelopment Plan Ministry of Lands & Housing Department Of Town & Regional Planning 2014

This plan serves as revision of part of the Kasane Kazungula Development Plan (2000- 2024). It presents the Conceptual and Development Frameworks for the redevelopment of the Kasane-Kazungula area into a renowned Tourism Hub. The plan follows the Kasane Kazungula Redevelopment Tourism Strategy which was prepared by Botswana Tourism Organisation (BTO) which provided the research necessary from a tourism perspective.

In terms of waste the plan highlights:

- i. To remain Environmentally Sustainable damage to the natural environment must be avoided. Development must conserve resources, particularly water and minimize, waste and pollution.
- ii. There are waste dumps which are not adequately managed and pose a potential threat of pollution. Their location at the gateways of the towns is an eyesore and threatens 'first impressions' of the project area,
- iii. A management plan should be provided to state the accessibility, waste control and general upkeep of public open space.

3.2.1.2 Environmental Inspection Report Ministry of Environment Natural Resources Conservation and Tourism Department of waste Management and Pollution Control, January 2020

Kasane landfill is included in this study. The reason for undertaking the assessment of 12 of the 14 government owned landfills in Botswana was as a result of the fact that the majority of these state-owned landfills operate without licensing due to non-compliance with the condition of the licenses issued for these landfills.

⁸ Environmental Assessment Act, 2011

The objective of the study was to ascertain challenges with respect to management of the activities undertaken at the sites. The following issues were assessed:

- i. Finance and budget allocations,
- ii. Operations and maintenance plans,
- iii. Cost recoveries for the waste disposal services,
- iv. Record keeping,
- v. Employee skills and competencies to manage the landfills.

3.3 Other Relevant Policies

3.3.1 Byelaws

The Chobe District has various Byelaws but non that specifically address waste management.

4. Waste Management

4.1 General Waste Management Concepts

4.2 Municipal Solid Waste

The following waste is generally considered to be MSW:

- Domestic Waste,
- Business waste not containing hazardous waste or hazardous chemicals,
- Non-infectious animal carcasses,
- Garden Waste,
- Waste packaging,
- Waste tyres,
- Building and demolition waste not containing hazardous waste or hazardous chemicals, and
- Excavated earth material not containing hazardous waste or hazardous chemicals.

4.2.1 Waste Hierarchy

In broad terms waste minimisation is aimed at reducing the generation of waste through education and improved production processes rather than aiming to better technology to improve treatment and disposal of waste. The idea of minimisation is not only centred on technological advances but can also be viewed as a method of managing existing resources and technology in order to maximise the efficiency of available resource usage. Minimising waste generation has the potential to reduce costs by maximising the use of resources and by reducing the amount of waste to be disposed of as a consequence, the lifecycle cost of waste management is therefore decreased. This approach starts at grassroots level and follows a three-tier approach:

Typical waste avoidance for individuals: Buying goods in bulk; reconsidering superfluous purchases; purchasing products in materials/packaging that is readily recycled or goods that are not packaged, for instance.

Waste minimisation in industry: Change in product design to reduce materials consumption; using crates instead of pallets to avoid the need for shrink wrap; incorporating Eco-Design technology into production processes; adoption of cleaner production practices that ensure avoidance through efficiency measures; and regular monitoring of waste reduction/resource recovery practices ensure reduction in waste volumes for treatment or disposal.

Waste minimisation for Local, District and National Government: Encourage community 'avoidance' activities, e.g. promote competitions rewarding initiative in this area of resource recovery; lead by example and provide facilities and infrastructure to assist industry, business and the community to undertake resource recovery practices, e.g. kerbside recycling and resource exchange registers, initiate greener procurement programmes.

Waste minimisation can be achieved through various methods and the following is a short description of each and are listed from the most to least desirable.

4.2.1.1 Avoid Waste:

Where possible and if not required the act of not acquiring materials which will become waste will minimise waste at the outset.

4.2.1.2 Reduce:

When acquiring products and materials, it may be possible to avoid redundant or unnecessary potential waste such as, packaging and this leads to less material that will become waste.

4.2.1.3 Reuse:

Using products and materials more than once before recycling or disposing, is a practical way to reduce waste. Examples of reuse initiatives include: (1) Product reuse - rethreading tires, recovery of demolition materials, reuse of packaging such as bags or containers, reconditioning and repair of tools e.g. sharpening of drilling equipment; (2) Materials reuse – Bottles, scrap paper for notes/phone messages, mulching; (3) Durable packaging - e.g. milk crates, bread trays, string or calico shopping bags.

4.2.1.4 Recycle:

Recycling is the breaking down of materials from waste streams into raw materials, which are then reprocessed either into the same material (closed loop) or a new product (open loop), generally including waste separation and material reprocessing. There are various materials that are suitable for recycling, and technology is continuously advancing to allow the recycling of more materials.

As mentioned before, the benefits of recycling do not lie solely in diversion of waste away from disposal but, more importantly, in the reduction of the amount of virgin resources that need to be harvested or mined and processed for the manufacture of new products.

4.2.1.5 Recover:

It is possible to recover constituents or energy from waste. Tyres for instance can be turned into fuels through pyrolysis; waste with high calorific value can be incinerated for the generation of power. Exhaust heat can be harvested in the same manner from other installations.

Other aspects that are also important when considering waste management generation include:

■ Proximity Principle

From a practical perspective it is beneficial to handle / treat / dispose of wastes at or near the point of generation as transport of sometime bulky materials is costly, unsustainable and time consuming.

■ Duty of Care

The producer of any waste has an obligation to ensure that all wastes generated as a result of their activities are dealt with in an appropriate manner taking into account all fiduciary and regulatory requirements. In essence this means that wastes from the point of generation, via any transport mechanism and to the point of final disposal must not constitute an unacceptable risk to human health, the environment and property up to treatment or safe disposal. The waste producer is also obliged to ensure all wastes that are re-used and recycled do not pose an unacceptable risk to human health, the environment and property.

4.2.2 Waste Characterisation

The characteristics of waste are what determines the recyclability of the waste. Although some waste is readily recyclable the market for the recyclables is what determines whether or not a certain type of waste is recycled.

Table 3 below indicates the classification of most of the wastes that can be expected to arrive at a landfill site. Note that hazardous wastes are included but if delivered to the landfill it must be rejected for collection and further treatment or disposal by specialised third party service providers.

Table 3: Waste classification

Waste Type	Hazardous or Non-Hazardous	Recyclable or Non-Recyclable	Biodegradable or Non-Biodegradable
Paper and cardboard waste	NHZ	RC	BD
China clay waste (broken crockery)	NHZ	RC	NBD
Electrical and electronic wastes	NHZ & HZ	RC & NRC	NBD
Glass	NHZ	RC	NBD
Insulation linings (fibre glass, etc.)	NHZ	RC	NBD
Metal wastes (scraps, chips, shavings, etc.)	NHZ	RC	NBD
Plastic waste	NHZ	RC	NBD (few are)
Rubber	NHZ	RC	NBD
Used tyres	NHZ	RC	NBD
Food waste from household and institutional kitchens restaurants	NHZ (usually)	NRC (some can be composted)	BD
Broken / waste storage materials	NHZ	NRC	NBD
Building wastes incl. Plumbing wastes, builders' rubble etc.	NHZ	NRC	NBD
Rags – uncontaminated	NHZ	RC	NBD (mostly)
Rags – Contaminated	HZ	NRC	NBD
Printing cartridges	HZ	RC	NBD
Used batteries (Pb, Hg-dry cell, Ni-Cd)	HZ	RC	NBD
Clarified solids from food industry	HZ	NRC	BD
Contaminated fat and particulates	HZ	NRC	BD
Food contaminated with thermophilic bacteria	HZ	NRC	BD
Food spoiled due to overheating	HZ	NRC	BD
Clinical wastes	HZ	NRC	BD & NBD
Hydrocarbon contaminated soils, used filters, or sludges from workshops	HZ	NRC	NBD

Waste Type	Hazardous or Non-Hazardous	Recyclable or Non-Recyclable	Biodegradable or Non-Biodegradable
Unused containers of paints, oils, varnishes, thinners, adhesives, etc.	HZ	NRC	NBD
A/c units containing either ODS as coolant or non-ODS with high GWP	HZ	NRC	NBD
Materials containing asbestos (brake linings or old roofing etc.)	HZ	NRC	NBD
Paint sludge	HZ	NRC	NBD
Sludge from wastewater treatment	HZ	NRC	BD
Wastes potentially containing mercury	HZ	NRC	NBD
Wood	NHZ	RC (also re-usable)	BD

5. Waste Quantities and Characterisation

5.1 Waste Quantities and Types

A waste sampling exercise was undertaken at the Kasane Landfill site during September 2020. The purpose of the exercise was to assess the composition of waste delivered to the landfill. The amount of waste per categories of waste in Table 5 was measured.

5.1.1 Waste Generation Rate

The waste generation rate for Botswana was predicted as follows⁹:

- i. 1.0 kg per person per day in Gaborone and Francistown;
- ii. 0.7 kg per person per day in other urban and semi-urban areas; and
- iii. 0.3 kg per person per day for villages.

Based on the population prediction by Stats Botswana¹⁰ of the areas services by the District that dispose waste at Kasane the following figures were calculated:

Table 4: Estimated Waste Quantities per Person per Day

Waste Generation	2020 Population	Waste Generation rate Kg/person/day	Daily Waste Quantity per person per day (kg)
Kasane	10298	0,70	7208,78
Kazungula	15689	0,70	10982,20
Satau	1903	0,30	570,84
Parakarungu	814	0,30	244,07
Kachikau	1254	0,30	376,22
Kavimba	2068	0,30	620,29
Mabele	3970	0,30	1191,13
Pandamatenga	1498	0,30	449,40
Lesoma	728	0,30	218,40
Total	38,222		21,861

This total amount of waste generated equates to approximately 8,000 tons per annum (including an estimate for December 2020 that was not included in waste the quantities report shown in Table 8) is approximately 8,400 tons per annum.

The estimated amount of waste generated per capita per day as shown in Section 5.1.1 (i) and (ii) is thus relevant.

5.1.2 Future Waste

5.1.3 Waste Categorisation

Table 5 shows the categories of waste that were measured during the waste sampling done in September 2020. The categories include all the types of waste that are expected to be disposed of at a general landfill site.

⁹ Feasibility Study of Waste to Energy in Botswana: Interim Report 5 Jan 2021

¹⁰ BOTSWANA POPULATION PROJECTIONS 2011 – 2026, Statistics Botswana 2015.

Table 5: Categories of Waste

Category	Description
Mixed paper	
High-grade paper	Computer printout
	Other office paper
Newsprint	
Corrugated cardboard	
Plastic	PET bottles
	HDPE bottles
	Plastic Film or sheets
	Other plastic
Food waste	
Wood	
Other Organics	
Ferrous Metals	Cans
Other Ferrous Metals	Scrap metal etc.
Aluminium	Cans
	Foil
	Other Aluminium
Glass	Clear,
	Brown,
	Green
Other Inorganics	
Textiles	

Many of the items measured above are recyclable. However, the waste sampling exercise measured all the waste that would be disposed of and not how much is recycled.

Table 6: Waste Composition for Kasane Landfill

Component	Percentage of Total	Moisture Content (%)
Mixed paper	9.06%	
High-grade paper	Computer printout	0.00%
	Other office paper	0.00%
Plastic		11.74%
	PET bottles	0.00%

	Other plastic	17.79%	
Food waste		6.04%	71.00%
Wood		13.42%	
Other Organics		4.03%	
Ferrous Metals	Cans	4.70%	
Other Ferrous Metals	Scrap metal etc.	0.00%	
Aluminium		0.00%	
	Cans	8.05%	
	Foil	0.00%	
	Other Aluminium	0.00%	
Glass		18.79%	
	Clear,	0.00%	
	Brown,	0.00%	
	Green	0.00%	
Other Inorganics		0.00%	
Textiles		6.38%	
TOTAL		100.00%	4.29%

Table 6 shows the category of waste as a percentage of the total.

5.1.4 Volumes of Waste Generated

The following quantities of waste were disposed of at the Kasane landfill during 2018 and 2019.

Table 7: Waste Quantities 2018 and 2019 Kasane Landfill

(Ton)	Foodstuff	Garden	General	Carcasses + Poultry	Total Rubble	Scrap Metal	Tyres	Sludge	Used Oil	Clinical	Com Waste	Paper	Total
2018	108.30	423.60	3 429.32	4.50	3 763.95	88.38	41.37	0.00	2.29	279.02	0.00		
2019	26.95	509.67	2 661.92	6.83	2 632.29	21.39	22.62	0.00	2.75	104.44	0.00	0.00	5 986.10

Table 8: Waste Quantities for 2020 from January to November

(Ton)	Foodstuff	Garden	General	Carcasses + Poultry	Total Rubble	Scrap Metal	Tyres	Sludge	Used Oil	Clinical	Com Waste	Paper	Total
January	6,3	62,2	381,7	0	257,1	0	0	0	0,3	4,9		0	712.5
February	2,7	119,6	316,5	1	297,6	1,6	1,5	0	0	15,2		0	755.7
March	1,78	46,8	253	0	424,9	2,76	2,76	0	0	3,6		0	735.6
April	3,6	38,3	199,86	0	209,34	7,78	2,92	0	0	9,74		0	471.54
May	2,76	70,98	192,54	0	470,36	2,58	0,8	0	0	17,4		0	757.42
June	1,98	40,11	161,92	0	270,18	1,49	0	0	0	19,89		0	495.57
July	1,8	112,7	179,29	0	210,8	1,69	0,5	0	0	16,6		1,9	525.28
August	1,92	121,4	237,8	0	391,5	3,78	2,63	0	0	15,2		0	774.23
September	1,55	123,5	370,9	0	289,4	4,36	0,7	0	0	16,8		0	807.21
October	8,18	197,8	173	0	349,02	0,8	1,34	0	0	84,4		0	814.54
November	0,86	47,88	199,76	0	565,1	0,38	0,48	0	0	14,18		0	828.64
TOTAL													7,678.23

5.1.5 Estimated Future Waste Quantities

The amount of waste generated per person per day will increase over time based on economic growth. According to <https://www.focus-economics.com>¹¹ the average economic growth rate of Botswana has been 3% per annum over the last 5 years. Based on 3% economic growth it is not expected that the per capita waste generation will increase substantially in the villages in the region but due to growth in the Tourism Sector an increase in waste generation can be expected for Kasane.

Table 9 shows waste quantities projected for the next 10 years assuming that waste generation will increase by 0.1kg per capita for the villages served by the landfill at during this period and increase by 0.3kg per capita over the same 10 years for Kasane and Kazungula.

Table 9: Predicted Waste Quantities for 2020 to 2030

Year	Foodstuff	Garden	General	Carcasses + Poultry	Total Rubble	Scrap Metal	Tyres	Sludge	Used Oil	Clinical	Com Waste	Paper	TOTAL
2020	36.47	1,070.48	2,908.66	1.09	4,074.87	29.69	14.87	0.00	0.33	237.72	0.00	2.07	8,376.25
2021	37.87	1,111.59	3,020.37	1.13	4,231.37	30.83	15.44	0.00	0.34	246.85	0.00	2.15	8,697.94
2022	39.33	1,154.31	3,136.44	1.18	4,393.98	32.02	16.03	0.00	0.35	256.34	0.00	2.24	9,032.20
2023	40.84	1,198.70	3,257.05	1.22	4,562.95	33.25	16.65	0.00	0.37	266.19	0.00	2.32	9,379.54
2024	42.41	1,244.82	3,382.39	1.27	4,738.54	34.53	17.29	0.00	0.38	276.44	0.00	2.41	9,740.47
2025	44.04	1,292.76	3,512.63	1.32	4,921.00	35.86	17.96	0.00	0.40	287.08	0.00	2.50	10,115.54
2026	45.74	1,342.57	3,647.97	1.37	5,110.61	37.24	18.65	0.00	0.41	298.14	0.00	2.60	10,505.30
2027	47.50	1,394.33	3,788.62	1.42	5,307.65	38.68	19.37	0.00	0.43	309.64	0.00	2.70	10,910.33
2028	49.33	1,448.12	3,934.79	1.48	5,512.42	40.17	20.11	0.00	0.44	321.58	0.00	2.80	11,331.26
2029	51.24	1,504.03	4,086.69	1.53	5,725.23	41.72	20.89	0.00	0.46	334.00	0.00	2.91	11,768.71
2030	53.22	1,562.13	4,244.56	1.59	5,946.40	43.33	21.70	0.00	0.48	346.90	0.00	3.02	12,223.34

¹¹ <https://www.focus-economics.com/countries/botswana>

6. STATUS QUO

6.1 Waste Collection Transport and Disposal

Waste Management is not seen as a very important issue among many, that the LA has to navigate daily. It is understandable that it is often left on the back burner and more pressing matters are focused on. Improper Waste Management has serious consequences that are normally not easily noticed unless you happen to drive by the landfill or happen upon an illegal dump. Waste collection and disposal infrastructure are well designed robust installations designed by professional engineers and consist of complicated systems.

Although Kasane has a well-engineered well-appointed landfill, the resources needed to operate it are lacking. Almost all the equipment including the incinerator are either past their *Sell By date* or do not have operators. The Landfill manager is new at his job and has only started learning how to manage a landfill site, without proper mentorship.

Waste management is an item for discussion on the regular council meeting but seems to be brushed over and not enough importance is assigned to it. In order for any waste management system to operate the political will must be there to facilitate this. Councillors and senior management of the LA must receive waste management training in order that they may give valuable and informative oversight.

6.1.1 Waste Collection and Transportation

Residential waste is collected according to the schedule in Table 10.

Institution, Commercial and Business waste is the responsibility of the generator and is dropped at the landfill and the landfill staff ensure that the waste is disposed of properly.

Waste that is collected from villages that are relatively far from Kasane use transfer cages. These cages are located within walking distance from residents where they place the waste in the cage. The waste is then collected weekly by the council and taken to the Kasane landfill site for disposal.



Figure 8: Typical Transfer Cage

Table 10: Waste Collection Schedule

DAY	WASTE COLLECTION SCHEDULE	COMPACTOR CREW
-----	---------------------------	----------------

Monday	<ul style="list-style-type: none"> ● Kazungula Old ● Kazungula Kgotla ● Kazungula primary. school cage, Gov. institutions 	TEAM A 1. Mufaladi Tutuwe 2. Mowa Mafikeng 3. Johnson Mosweu 4. Wedu Mokhuhlane 5. Mpho Simata 6. Mooketsi Simasiku 7. Getrude Mmolawa 8. Annah Kgalemang
Tuesday	<ul style="list-style-type: none"> ● Kazungula New ● Kazungula Flower town ● Plateau primary. school cage ● Kasane primary. school cage, Gov. institutions 	TEAM B 9. Lebonye Basiamé 10. Kedibonye Shamuka 11. James Makuyungo 12. Kashi Sikambo 13. Chauto Pelaelo 14. Obert Tshosa 15. Kephaketse Molemele 16. Lebalang Moatswi
Wednesday	<ul style="list-style-type: none"> ● Parakarungu (1 cage) ● Satau (1cage) ● Litter picking along Kazungula –Lesoma road 	TEAM C (CHOBE EAST AND CHOBE WEST) 17. Machana Masene (Mabele) 18. Ndana Ketlalebakae Sanyumba (Kavimba) 19. Lesego Daniel (Kavimba) 20. Modimoohilwe Muyoba (Kachikau) 21. Gaselaope Kasale(Kachikau) 22. Keitumetse Mozevi (parakarungu) 23. Kabuba Chisamu (parakarungu) 24. Namatama Nsundano (Satau) 25. Simasiku Nsala (Satau) 26. Samuel Namakando (Lesoma) 27. Maria Mafikizolo (Pandamatenga)
Thursday	<ul style="list-style-type: none"> ● Kachikau (6 cages) ● Kavimba (1 cage) ● Mabele (1 cage) ● Litter picking along Kazungula –Lesoma ro 	
Friday	<ul style="list-style-type: none"> ● Pandamatenga (3 cages) ● Lesoma (1 cage) ● Litter picking along Kazungula –Lesoma road 	

The distances from villages to the landfill site are listed in Table 11

Table 11: Approximate Travel Distances to Villages from Kasane Landfill

Village	Distance to Kasane Landfill in kl
Parakarungu (1 cage)	123
Satau (1cage)	113
Kachikau (6 cages)	92
Kavimba (1 cage)	81
Mabele (1 cage)	68
Pandamatenga (3 cages)	111
Lesoma (1 cage)	22

6.1.1.1 Hazardous waste

Clinical waste is incinerated at the landfill site. There is a building specifically for housing the incinerator and it is located approximately 300m South of the main buildings along the western fence of the landfill. Clinical waste is collected according to the schedule in Table 12.

Table 12: Clinical Waste Collection and Incineration Schedule

Day	Hazardous Waste Schedule	Compactor Crew
Monday	□ Kasane primary hospital	TEAM A 1. Samuel Kegatetse 2. Donana Swele
	□ Kasane clinic	
	□ Kazungula clinic	TEAM B 3. David Ookeditse 4. Betty Ndana Crew change on weekly basis for both collection and incineration
	□ Plateau clinic	
	□ All home-based care patients in Kasane and Kazungula	
	□ Trade premises in Kasane and Kazungula	
Tuesday	□ Chobe east	
	□ Pandamatenga and Lesoma	
Wednesday	□ Chobe west	
	□ Mabele, Kavimba, Kachikau, Satau, Parakar Clinic	
	□ Including trade premises and home-based c patients	
Thursday	□ Incineration	
Friday	□ General cleaning of incinerator	

6.1.1.2 Issues with Waste Collection and Transportation

The following is a list of issues that were identified and need addressing by the LA. Further issues were identified by residents during public participation and are listed under Section 7.1

i. Planning

Although the routes for collecting and transporting waste are done according to the schedule in Table 10 there is no redundancy or contingency in place for breakdowns and other unforeseen events. The LA often has to bring in private contractors to do the collection of waste due to breakdowns.

ii. Personnel

The LA has 40 collection personnel, and this is enough to cover the actions of collecting waste. The problem however is the lack of more senior personnel to manage these activities and to do law enforcement.

iii. Waste Receptacles

According to the quarterly financial report submitted to the Department of Waste Management & Pollution Control a high percentage of residents have waste bins that were issued to them by the LA. The percentage is as high as 82%.

Although the number is high, the steel drums used by some residents can be problematic for collection crews if the drums are rusted or very heavy and may cause injury such as cuts or muscle strain during placement in the collection vehicle.

iv. Littering

Littering is a problem, and this not only is it unsightly, but it impacts negatively on the operation of waste collection in the LA.

v. Issues with Waste Collection and Transportation Equipment

Only one of the collection compactor trucks was operational at the time of writing this plan. This not only means that the service cannot be delivered but also that the collection crews are not being utilise properly.

No	Make	Model	Year Model	Body Type	Condition	Malfunction
1	Toyota	Hino	2003	Truck	Operational	No batteries, electrical problems and mounting
2	Toyota	Hino	2003	Compactor Truck	Not Operational	Clutch needs replacing
3	Nissan	UD 80 C	2011	Compactor Truck	Operational	
4	M.Ferguson	MF365	1992	Tractor (skip)	Operational	
5	Toyota	Hino 13237	2008	Truck	Operational	Gear Lever Malfunction
6	Nissan	UD 60 B	2012	Truck	Operational	

6.1.2 Waste Disposal

All Non-hazardous waste except for clinical waste is currently disposed of at the Kasane landfill site. The landfill is located on the South Eastern corner of the A 33 and President Avenue, Kasane. The site is approximately 4 km to the east of Kasane and 4 km west of Kazungula. The license for the landfill site lapsed due to non-compliance with the conditions of the license.

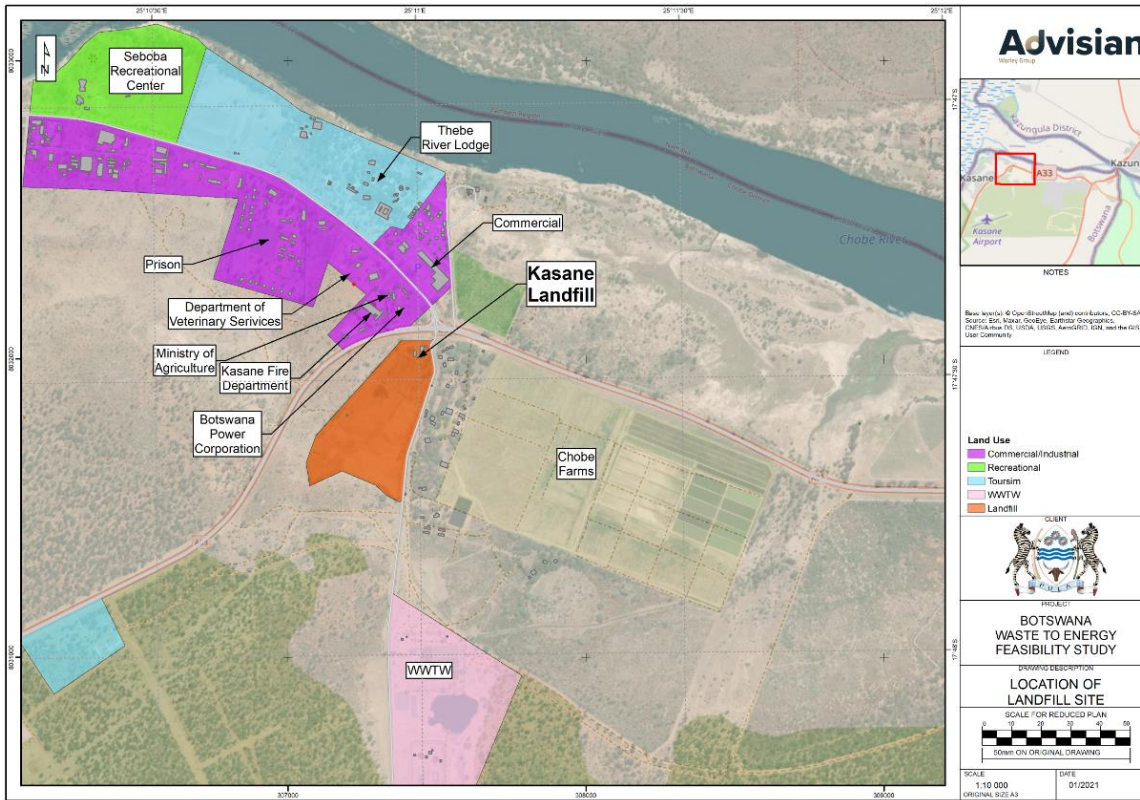


Figure 9: Kasane Landfill Location

6.1.3 Landfill information

Table 13: Landfill Information Sheet

KASANE LANDFILL					
GPS CO-ORDINATE	17°47' 29"S 25°58'10".	LICENSE	Expired Jun 2018	CLASSIFICATION	G:M
LANDFILL FOOTPRINT	The site is 16ha but the landfill in use is 3ha	REMAINING LIFESPAN		WASTE TYPE HANDLED	Garden Refuse and Builders Rubble
SURROUNDING LANDUSE	Bordered to the east by Chobe Farms and to the West by Ngoma-Kasane road				
DESIGN QUANTITY (tonnes per year)	65,000 However, this is always being exceeded. The lowest amount was received in 2010 (78,000) and the highest was received in 2013 (106,700). It is likely that airspace will be finished before the envisaged life of landfill. Additional space is available for landfill expansion.				
AREAS SERVICED BY LANDFILL	Kasane and Kazungula	NO. OF STAFF PRESENT ON SITE?	7	ODOUR/VERMON CONTROL?	Flies are problematic
SECURITY/ACCESS CONTROL?	Site completely fenced off with electric fence and has entrance with access control and weighbridge				
WEIGHT BRIDGE	1x30 ton Weight bridge, data captured at entrance				
LANDFILL EQUIPMENT	<ul style="list-style-type: none"> i. 4 landfill compactors (only 2 operational) ii. 1 tyre cutter (not used due to lack of operator) iii. 2 tipper trucks iv. 1 incinerator (176kg/hour) v. 1 front end loader (not operational) vi. 1 weigh bridges (30-ton max) vii. 1 wood shredder (not used due to lack of operator) viii. 2 water bowsers (not operational) 				

KASANE LANDFILL					
FIRE FIGHTING	No firefighting system in place				
WASTE HOLDING AREA	No	BACKUP GENERATOR	Yes	SCAVENGERS PRESENT?	No
RECYCLING ACTIVITIES?	A small amount of materials is collected for recycling consisting mostly of metal scrap, waste tyres, electronic waste and packaging waste				
ANNUAL AUDITS?	No,	LEACHATE	Available and working. However, leachate collects into the same pond as stormwater, which can lead to overflow during heavy rains.		
STORMWATER MANAGEMENT?	System in place and operating	WATER MONITORING?	1 borehole drilled for water quality monitoring; water sampling done once annually.		
WASTE DISPOSAL PROCEDURE?	Waste is offloaded at cells, then spread/compacted, finally cover material placed on cell (RAMP METHOD)				
SOURCE OF COVER MATERIAL	From site, non-contaminated building rubble also used as cover material.				
REHABILITATION	The is not an ongoing rehabilitation plan.				

6.1.4 Hazardous Wastes

No hazardous waste is accepted at the site. However, Tshole Trust has an onsite oil tank and they collect the used oil for recycling.



Figure 10: Used Oil Receiving Tank

Due to the risk of contamination of the environment and dangers associated with hazardous waste the Local authority still has a responsibility to ensure the safe treatment or disposal of hazardous waste even though they do not perform this function themselves except for clinical waste that is incinerated. To this end if any hazardous waste is diverted from the landfill or collected by a third party the local authority must from time to time require waste manifests to verify such.

Household hazardous waste such as fluorescent tubes paint cans and solvent containers will often be mixed with general waste.

6.1.4.1 Issues with landfill Operations

The landfill currently experiences challenges that influence to proper operation of the site, these include but are not limited to:

i. Planning

Activities at the landfill site are done on an *ad hoc* basis. There is no evidence that the disposal activities on the workface are not determined ahead, disposal vehicles arrive at the site and are sent to the workface but roads on the existing waste body are not demarcated.

ii. Access and Security

The electric fence is not operational and the signage at the gate is eligible. There is a gap between the weighbridge and the ground and waste, and other matter can get under the bridge, it is also a hazard for personnel and users of the site (Figure 12).



Figure 11: Entrance Signage



Figure 12: Open Side of Weighbridge

Weighbridge: The weighbridge operators provide a vital role at the landfill. The function of the weighbridge is crucial in recording who drops off waste and the amount. Accurate recording of this, enables the gate fees to be quantified and has a direct impact on cost recovery. At the time of writing this plan there was only one operator and the LA requires two, therefore impacting directly on the aforementioned.

Incinerator: The incinerator was not functioning properly at the time of writing the plan as shown in Figure 13. There was also only one operator, and the second operator post was not filled, again impacting directly on the operation of the equipment. Although the incinerator may have to be replaced the black smoke is a result of incomplete combustion indicating that the unit is being fed at a rate higher than the installation is designed for.



Figure 13: Incinerator Chimney Stack

iii. Aesthetics

The site is visible from the main road from the airport and the border post by any vehicle passing by. This includes tourists that visit the area. The site is an eyesore due to problems with infrastructure, equipment, nuisance and lack of proper operations.

The lack of housekeeping, windblown litter, foul odours and a column of thick black smoke from the incinerator make the facility very unsightly.

iv. Nuisance

Landfill fires occur frequently and cause nuisance for nearby residents and there is a fly infestation that causes nuisance for the industrial area in close proximity to the landfill. Not having sufficient cover material causes vectors that can carry disease and compound the odours produced at the landfill.

v. Housekeeping

Outside of the waste cell and leachate/stormwater pond, the landfill site in general is not well maintained and kept clean:

- Vegetation such as weed and grass are not removed (e.g. Figure 14, Figure 15 and Figure 16) and in the dry season increases risk of fires spreading,



Figure 14: Security Access Building



Figure 15: Storage Cages



Figure 16: Vegetation Around Electrical Box

- Areas around buildings are not kept clean (Figure 16),
- There is not proper litter control,
- There are oil/hydraulic fluid spills at the oil collection area and around stationary equipment such as the landfill compactor (Figure 17.)



Figure 17: Oil Spills

vi. Hazardous waste

Batteries, electronic waste, chemicals, and waste from autoclaves can cause fires. And the landfill spotter or incinerator operator must be trained to identify these potential dangers.

vii. Incineration

The Kasane Landfill incinerator has a capacity of 50kg/hr of clinical waste. Analysis of clinical waste records indicates that the district generates around 70 000kg clinical waste annually which translates to around 50kg/day. However, during inspection of the incinerator facility, it was observed that it was discharging black smoke indicative of incomplete combustion leading to air pollution and associated negative health impacts.

viii. Leachate Collection System and Stormwater Control

Although there is a functioning leachate collection system, the dirty stormwater from the landfill drains to the same pond during rainfall events. During heavy rain this may impact the capacity of the leachate system to accommodate the volume of both liquids. Leachate production is a function of the moisture content in the waste body, therefore, not only does stormwater flow to the pond directly but it percolates through the landfill and increases leachate production compounding the problem.

ix. Cover material

There is insufficient cover material on site leading to larger exposed waste that add and cause the issues mentioned above.

x. Security

The electric fence surrounding the site is not functioning and this can lead to uncontrolled access of waste pickers to the landfill.

xi. Landfill Airspace

The remaining airspace is estimates based on the amount of waste that is disposed of. This method, although indicative is not accurate enough for planning of phase 2 for the construction of a new cell. The cell must be completed by the time the phase I landfill is full. No topographical survey has been performed on the site since it started operations.

Landfill equipment is one of the keystones of proper sanitary landfilling. Non-functioning landfill equipment severely impacts the problems mentioned under Section 6.1.4.

xii. Compaction

A landfill has a finite design life, and this is directly influenced by the density of the waste body. A landfill compactor's function is to spread waste and increase the density of the waste thereby reducing the volume. Depending on the size of the machine and factors such as the slope of the working face, the ability of the operator and the existing density of the waste delivered to the site, (anywhere between 150kg/m³ and 350kg/m³) the compacted waste can be up to 1000kg/m³ and 1200kg/m³ if done very well. Using a landfill compactor will therefor extend the life of the landfill. The saving in landfill airspace not only increases the life of the landfill but has additional benefits such as a saving on land acquisition to accommodate a new landfill once the landfill in question is full. Waste has weight and therefore does self-compact over time, but the benefit is very small.

The operational landfill compactor at the Kasane landfill is more than 10 years old and it is operating beyond its design life.

xiii. Dust suppression

Landfilling creates a large quantity of dust, especially in very dry climates. There is dust generated at the workface with the placement of cover, dust from the roads as vehicles drive over them and windblown dust from areas with no vegetation. The dust from landfill sites often contain harmful emissions depending on the waste being disposed of at a given time. Both water bowsers are not working at the moment.

xiv. Issues with Landfill Equipment

Table 14 below shows the equipment that is currently used at the landfill site and the problems associated with each one.

Table 14: Landfill Equipment Inventory

No	Make	Model	Year Model	Body Type	Condition	Malfunction
1	Toyota	Hino	2008	Truck	Not Operational	
2	Toyota	Hino	2008	Truck	Operational	
3	Toyota	Hino	2009	Water Bowser	Not Operational	Gearbox needs replacing
4	Toyota	Hino	2009	Water Bowser	Not Operational	No batteries, registration expired and malfunction of water pump
5	JCB	3CX5MT	2008	TLB	Not Operational	

No	Make	Model	Year Model	Body Type	Condition	Malfunction
6	Caterpillar	816f	2009	Landfill Compactor	Operational	
7	Morbark	Twister		Woodchipper	Not Operational	No Operator
8				Tyre Shredder	Not Operational	No Operator
9	Incinerator					Incomplete Combustion

The woodchipper and tyre shredder are currently standing idle due to a lack of qualified or trained operators.

xv. Servicing and maintenance of equipment:

The servicing and maintenance of the landfill equipment except for the weighbridge and incinerator is done in-house by the LAs Technical Section. The technical section does not have the capacity or capability to service the equipment properly.

All equipment have service intervals specified by the supplier and very often come with operational manuals. There is no planned servicing of equipment and equipment is only repaired when it malfunctions. The majority of vehicles at the landfill site are either non-functioning or are operating with defects.

There is no replacement plan in place and all the equipment has reached the general end of useful life. This situation leads to a scenario where most of the equipment is not working and almost all of it has to be replaced at once.

xvi. Waste Management Personnel

The landfill is managed by a staff compliment of seven 7 people including the landfill manager. The requirement for proper operation of the site is at least 10 people. The current landfill manager has only recently started working at the landfill and is still learning the landfill operational processes. There is also not a qualified person with the relevant experience to develop the skills of the incumbent. The operators and other personnel are not trained, have the capacity or the numbers for proper operation of the site and this leads to inferior service delivery and operation of the landfill. Both the incinerator and weighbridge require additional personnel.

Other equipment such as the tyre shredder and woodchipper are not utilised at all due to the absence of dedicated trained operators.

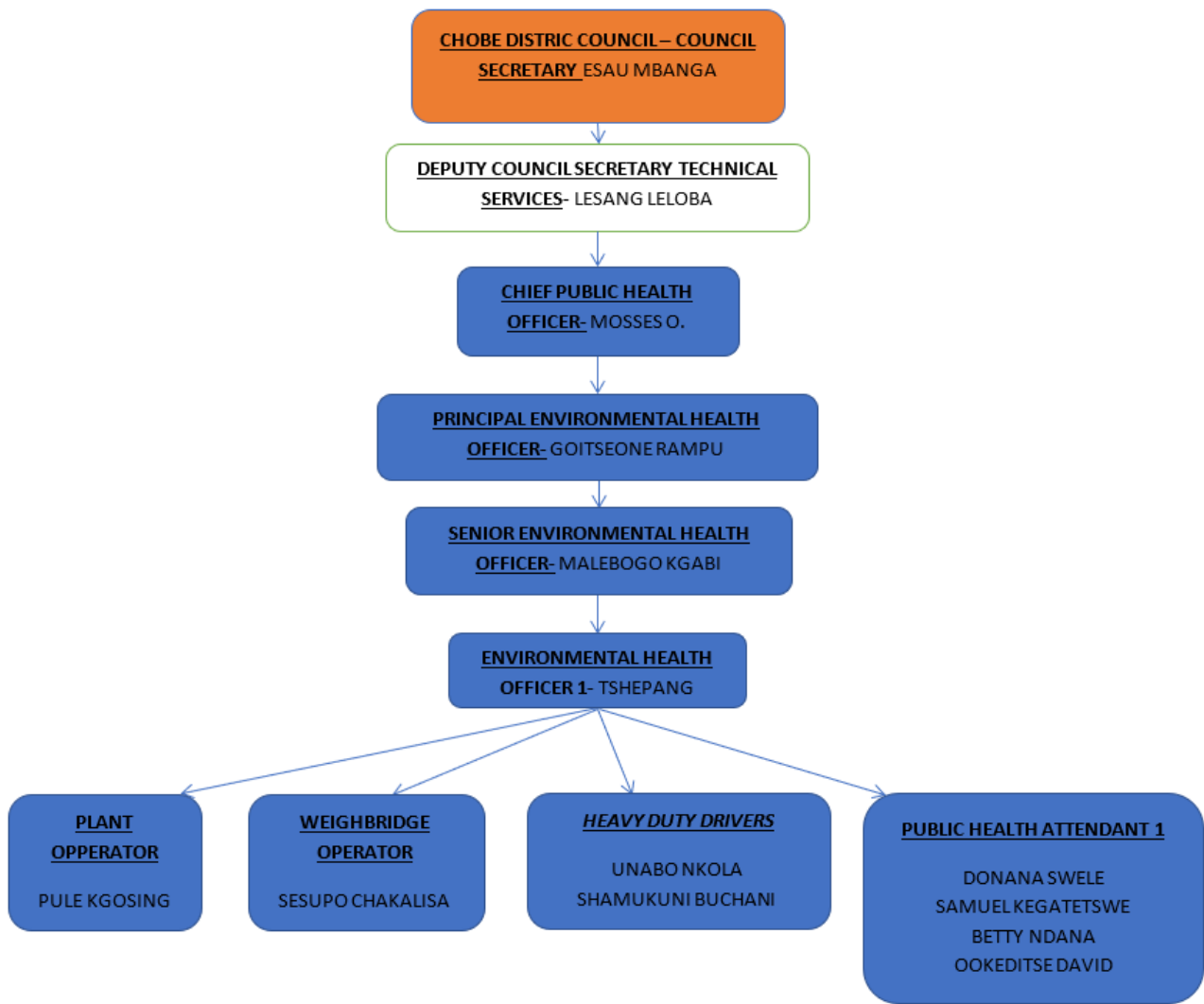


Figure 18: Public Health Organogram

6.1.5 Illegal dumping

Although illegal dumping is not rampant in Chobe, but it does happen, and this is a danger to the environment especially where animals ingest waste.

6.1.6 Environmental Monitoring

The site has one monitoring borehole to access groundwater contamination.

Monitoring test results indicate groundwater contamination since at least 2016. Although contamination is evident no attempt has been made to establish if the contamination is a result of the operation of the landfill site. There is also no surface water testing.

The sampling only mentions that samples are taken at the landfill by officials from the LA. There is not sampling procedure in place.

6.1.7 Recycling

Very little recycling is done at the landfill. There are 6 Informal Sector Recyclers on the landfill, and they are provided with a letter to allow authorised access to the site for waste picking.

Figure 19: Waste Section Organogram

The recycled waste is placed in the open and a storage area for recyclables is being planned.

According to the landfill statistics At the moment 9.24 tonnes of waste is collected for recycling from the landfill. This is only approximately 1% of all the waste delivered to the landfill.

6.1.8 Byelaws

The existing byelaws do not address waste management and only refer to the Waste Management Act.

7. STAKEHOLDER ENGAGEMENT

Waste management systems only function properly if all parties adhere to policies and these policies must serve the needs of all concerned in as far as is possible.

During Phase 3 of the Botswana Waste Energy Project a public participation process was undertaken.

The following is a short description of the procedure followed during the public participation survey.

A Local Botswanan Environmental company did a household survey in Kasane and Kazungula. 93 households were visited in Kasane and 81 in Kazungula. Letters detailing the waste collection were handed to stakeholders and a door to door survey were conducted by enumerators using a standard questionnaire. Refer to Appendix C for the questionnaire.

7.1 Public Perceptions and Current Waste Management Practices

Refer to Section 2.2.1.2 for the income groups, Employment and Vulnerability.

7.1.1 Waste Collection

Approximately half of the residents questioned did pay for the collection service at a rate of BWP 10.00 per month for Kazungula and BWP 12.00 for Kasane. However, 90 (97%) households in Kasane and 74 (91%) in Kazungula indicated that they could afford the service.

All residents in both Kasane and Kazungula have weekly household waste collection and are satisfied with the service that they receive.

In Kasane 89 (98%) households consider the collection service to be reliable and rate it 8 out of ten and in Kazungula 59 (73%) consider it to be reliable and rate it 7 out of 10.

The most common issues highlighted by the households from both Kasane and Kazungula were:

- i. The fact that animals including baboons scatter waste by ripping bags open or emptying drums or bins with no lids,
- ii. Some residents leave their waste in front of neighbouring properties on collection days,
- iii. Many residents don't have bins that were issued by the LA or the bins they have are not in good condition,
- iv. The LA does not collect garden waste.

7.1.2 Awareness And Education

The following issues were highlighted in terms of lack of knowledge of residents:

- i. There is a problem with littering by residents in the streets,
- ii. People are unaware of the importance of proper waste management.

7.1.3 Recycling And Waste Minimisation

The results of the public participation included the percentage of waste constituents and how the household handles each particular form of waste. Analyses of the results can be seen in the Table 15 and Table 16 below

7.1.3.1 Kasane

Table 15: Waste Handling Per Household for Kasane

The average percentage of households that use the following Waste management Options												
	Average Percentage of Household Waste	Disposal	Compost	Animal Feed	Recycling	Incineration	Sell for Recycle	Reuse	Sell for Recycle and Disposal	Reuse and Disposal	Disposal and Recycling	Incineration and Disposal
Food	29%	35.48%	3.23%	51.61%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Garden waste	12%	34.41%	2.84%	2.15%	0.00%	3.23%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Plastic (bottles, packaging, bags etc.)	33%	69.89%	0.00%	0.00%	0.00%	0.00%	0.00%	18.28%	0.00%	0.00%	0.00%	0.00%
Paper cardboard /	9%	81.72%	0.00%	0.00%	0.00%	1.08%	0.00%	3.23%	0.00%	0.00%	0.00%	0.00%
Glass	3%	16.13%	0.00%	0.00%	8.60%	0.00%	0.00%	4.30%	0.00%	0.00%	0.00%	0.00%
Wood	11%	21.51%	0.00%	0.00%	0.00%	32.26%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Metal	0%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Textiles	3%	27.96%	0.00%	0.00%	0.00%	1.08%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Electricals (mobile phones, tvs, etc.)	0%	3.23%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Oil	0%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%

7.1.3.2 Kazungula

Table 16: Waste Handling Per Household for Kazungula

The average percentage of households that use the following Waste management Options												
	Average percentage of Household Waste	Disposal	Compost	Animal Feed	Recycling	Incineration	Sell for Recycle	Reuse	Sell for Recycle and Disposal	Reuse and Disposal	Disposal and Recycling	Incineration and Disposal
Food	29%	29.63%	3.70%	41.98%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Garden waste	12%	24.69%	8.64%	0.00%	0.00%	3.23%	12.35%	0.00%	0.00%	0.00%	0.00%	0.00%
Plastic (bottles, packaging, bags etc.)	33%	82.72%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Paper / cardboard	9%	81.48%	0.00%	0.00%	0.00%	1.08%	2.47%	3.70%	0.00%	0.00%	0.00%	0.00%
Glass	3%	11.11%	0.00%	0.00%	9.88%	0.00%	0.00%	1.23%	0.00%	0.00%	0.00%	0.00%
Wood	11%	22.22%	0.00%	0.00%	0.00%	32.26%	35.80%	0.00%	0.00%	0.00%	0.00%	0.00%
Metal	0%	2.47%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Textiles	3%	24.69%	0.00%	0.00%	0.00%	1.08%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Electricals (mobile phones, tvs, etc.)	0%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Oil	0%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%

Table 15 and Table 16 show that the majority of waste generated by the households is disposed of, even so, food waste is often used as animal feed and wood is incinerated for heat and cooking. This is a form of waste minimisation as the waste is diverted from landfill. It is especially desirable to avoid food waste from going to landfill as it breaks down anaerobically in the landfill and produces methane that is a potent greenhouse gas.

8. WASTE MANAGEMENT IMPROVEMENT

8.1 Waste Collection Transport and Disposal

8.1.1 Waste Collection and Transportation

i. Planning

Waste collection is planned according to the schedule in Table 10 and clinical waste according to the schedule in Table 12.

Regular monthly planning meetings should be held by management and supervisors of collections. The agenda should include:

- Budgets and expenditure,
- Servicing of vehicles and contingency plans when these vehicles are not operating,
- Preventative maintenance such as the condition of tyres,
- Feedback from inspections,
- Cleaning arrangements of vehicles,
- Planning of safety talks with crew members (toolbox talks),
- Performance of personnel,
- Vacant posts and ways to attract qualified people.

An attendance register must be kept, and minutes taken of each meeting. Any action items should be assigned to specific personnel and dates given for completion of these actions. If items are not actioned in the given timeframe responsible parties must give feedback on the reasons for this at the next meeting.

Meetings with drivers and crew must also be arranged. These meetings are more casual however, the manager or supervisor must plan the matters for discussion at the meeting. Safety should always be addressed at the start of these meetings. During the meeting the leader of the meeting must record issues or concerns from attendees. These issues must then form part of the agenda for discussion at the management meetings.

ii. Personnel

The LA must ensure that the vacant positions are filled with suitably qualified personnel and that they receive the training required to fulfil their duties effectively. Depending on the level of training required, general labourer versus compactor operator, it has to be decided whether to provide in-house training or whether to provide the employee with specialised training. In-house training should only be attempted if the capacity and knowledge exist within the LA. It is recommended that specialists be appointed to provide more specialised training.

The safety of personnel is extremely important and the collection of waste and transferring the waste from bins (and especially steel drum) is dangerous.

Proper PPE must be issued to collection crews including items such as gloves and safety boots. Due to the possibility of sharps and other clinical waste that may seriously impact on the health of collection staff, they must have specialised PPE including the appropriate gloves, overalls and masks.

iii. Waste Receptacles

The LA must plan the replacement of waste receptacles that are not in line with the standard bins provided by the LA. It is recommended that this be phased in to have the least impact on the budget.

iv. Waste Collection and Transportation Equipment

The entire current collection fleet must be replaced. It is proposed that the current vehicles are assessed by competent technical personnel to ascertain which vehicles need to be replaced in the very short term. If vehicles can be repaired to a functional level possibly using spare parts from similar vehicles that will be decommissioned, this may extend the useful life of the vehicle to facilitate a phased replacement schedule.

The fuel consumption of vehicles that travel to the outlying villages must be monitored against standard consumption of these vehicles to ensure that costs are kept to a minimum due to the large distances in question.

v. Servicing and Maintenance of Equipment

A proper preventive maintenance programme must be implemented to extend the life of equipment and reduce the current downtime. The council must be made aware of the importance of funding for operational expenses and made to understand the importance of maintenance. It may be necessary to get the Department of Sanitation and Waste Management to follow up on the performance of the council in this regard.

If equipment is properly maintained the lifecycle cost goes down and in the long run puts less pressure on budgets. Spare parts recommended by the manufacturer must be purchased and be available for repairs to prevent delays in operational time of equipment.

If maintenance is planned well in advance it will give the technical section the ability to plan for working on the equipment and reduce any delays.

vi. Littering

Litter is collected but the LA must embark on an education program to make residents aware of the negative impacts of littering, not only from an aesthetic standpoint but also the additional manpower required to collect the litter.

8.1.2 Waste Disposal

8.1.2.1 Hazardous Wastes

The access control/security personnel must be trained to identify hazardous waste that is not permitted at the landfill and know the appropriate procedure to inform drivers what to do with the waste. If hazardous waste is identified on the landfill working face the landfill spotter must ensure the waste is taken to a storage area where it can be collected by a third party for appropriate treatment or disposal. In as far as is possible the party that delivered the waste must be identified to ensure the LA is remunerated for the cost.

Household hazardous waste that includes empty paint and solvent containers and fluorescent tubes can be disposed of at the landfill but not in larger quantities.

8.1.2.2 Issues with landfill Operations

i. Planning

As with collection, planning is vital to the proper operation of the landfill. Regular monthly meetings should be held with management, these meetings can coincide with the collection meetings due to the coinciding matters that will be discussed.

The landfill manager must have daily tasks for personnel on the landfill and also regularly meet with them to discuss issues. These may relate to equipment, competency and safety matters.

Regular toolbox talks must take place and it is a good idea to have different members of a staff share their experience and knowledge with others.

ii. Access and Security

Vehicles arriving at the landfill must be guided to the relevant section. No unauthorised person must be allowed to access the landfill without being directed to the landfill manager. A landfill can be a very dangerous place and where people who may be there for purposes such as monitoring, they must be accompanied by a staff member at all times.

The weighbridge operator must also be available for the arrival of the disposal vehicles and ensure that the amount of waste arriving at the site is recorded.

iii. Personnel

As with collection, the LA must ensure that the vacant positions are filled with suitably qualified personnel and that they receive the training required for fulfilling their duties effectively as a matter of urgency. Depending on the level of training required, general labourer versus compactor operator, it has to be decided whether to provide in-house training or whether to provide the employee with specialised training. In-house training should only be attempted if the capacity and knowledge exist within the LA. It is recommended that specialists be appointed to provide more specialised training.

A landfill spotter has an important function at the landfill, and he/she must guide vehicles to the appropriate areas at the working face for disposal. The person must be properly trained to ensure that waste recycling collectors are a safe distance from disposal vehicles during dumping and are not near the landfill compactor when it is doing passes. If this post is not currently in the structure it must be added.

The appropriate PPE must be issued to personnel who work near the heavy machinery or who inspect activities on the operating area of the site. Items such as gloves and safety boots must be issued. Due to the possibility of sharps and other clinical waste and fugitive emissions from the incinerator door that may seriously impact on the health of incinerator operators, they must have specialised PPE including the appropriate fireproof gloves, fire resistant overalls and masks.

There are currently a woodchipper and a tyre shredder that are not being used due to the lack of qualified operators. Two operators must be employed to use the equipment and the necessary training must be provided. The new operators may have to be sent for training in one of the major centres such as Gaborone or if the expertise is only available in South Africa the qualified trainer may have to be brought in to do the training.

iv. Aesthetics

The litter fencing must be installed as soon as possible to stop windblown litter from getting caught in the perimeter fence or blowing out of the site.

The recycling shed will also help to organise recycling in order that it is not scattered or standing in open areas.

To shield the site from view from the main road a large berm can be constructed along the perimeter fence on the road reserve or a concrete palisade fence can be installed.



Figure 20: Example of a Concrete Palisade Fence

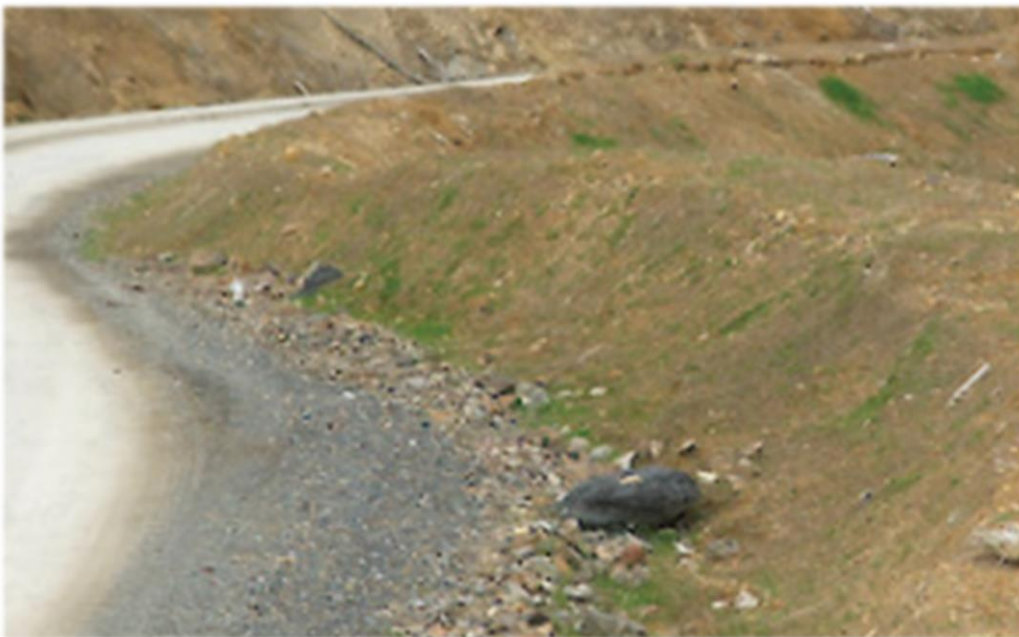


Figure 21: Example of a Berm Along a Road

v. Nuisance

To control the smell and the vectors at the landfill it is essential that the working face is kept to a minimum and that cover is placed at the end of the day.

vi. Housekeeping

It may be necessary to employ additional staff to keep the landfill clean outside of the landfill cell and leachate/stormwater pond. Weeds and dry grass must be removed from around buildings, at the entrance and around the oil collection area.

The oil spills must also be addressed immediately, and spill clean-up kits must be purchased and be available for use in the case of any new spillage of oil or hydraulic fluid or other hazardous liquids.

Litter that is strewn around the site especially in the perimeter fence must be removed continually.

vii. Incineration

According to the LA the incinerator must be replaced and there is an incinerator available that can be transported to the site.

This action should be further investigated and if the LA has the capability it must be moved. Alternatively, an external service provider can be appointed to collect the incinerator.

In the interim the smoke is most likely caused by over feeding the incinerator, not getting the combustion chamber up to temperature causing incomplete combustion. The landfill manager must inspect the placement of clinical waste into the incinerator and see if feeding is slowed down if the smoke is reduced.

The service provider that services the unit can also be approached to see if they can assist the operator in this respect.

viii. Leachate Collection System and Stormwater Control

There is a leachate and stormwater collection pond. It is not clear if the pond has overflowed in rainstorms but if it has it is proposed that additional material be added to the top of the surrounding berm to increase the height. To do this a source of suitable material must be found. This cannot be done inhouse without an engineering design. A qualified engineer must be appointed to do the design and supervise the work.

This only needs to be done if the capacity of the pond is not sufficient. Current information suggests that the pond may overflow but specific instances have not been given.

ix. Cover material

A commercial or alternative source will have to be found to supply a stockpile of cover material that can be continually replenished to ensure enough cover material for at least a weeks' worth of landfilling.

x. Security

The electric perimeter fence must be repaired

xi. Landfill Airspace

To accurately calculate the remaining airspace a topographical survey must be undertaken. The topographical model must then be assessed by a qualified civil/waste management consultant who will compare the current extent of the waste that has been disposed of against the original design.

This exercise must be undertaken from time to time, the interval will be determined by the specialist who does the calculation based on the rate that the cell has been filled to date.

i. Compaction

Continued compaction of waste as it is disposed of is essential to facilitate daily cover and compact the waste body. The operator must use the landfill compactor to spread the waste as it is dumped and do the required number of passes to achieve maximum compaction.

ii. Dust suppression

Continued dust suppression must be undertaken on the roads on the landfill and the demarcated accessway to the working face by the water bowsers. Whenever there are winds blowing areas that create windblown dust must be wet if the bowsers have access to the area.

iii. Landfill Equipment

All the vehicles at the landfill must be replaced. It is proposed that the current vehicles are assessed by competent technical personnel to ascertain which vehicles need to be replaced in the very short term. If vehicles can be repaired to a functional level possibly using spare parts from similar vehicles that will be decommissioned, this may extend the useful life of the vehicle to facilitate a phased replacement schedule.

iv. Servicing and maintenance of equipment

A proper preventive maintenance programme must be implemented to extend the life of equipment and reduce the current downtime. The council must be made aware of the importance of funding for operational expenses and made to understand the importance of maintenance. It may be required that the district or the Department of Sanitation and Waste Management make the council aware of the importance of the aforementioned.

If equipment is properly maintained the lifecycle cost goes down and in the long run puts less pressure on budgets. Spare parts recommended by the manufacturer must be purchased and be available for repairs to prevent delays in operational time of equipment.

If maintenance is planned well in advance it will give the technical section the ability to plan for working on the equipment and reduce any delays.

The equipment such as the woodchipper and the tyre shredder that are not operational may require specialised servicing or maintenance and the technical section should be made aware of this and if necessary technical personnel may have to be trained or the equipment must be sent for repairs to the supplier who may only have a presence in Gaborone or South Africa in which case the technical personnel may have to be brought in for the repairs.

8.1.2.2.1 Waste Management Personnel

8.1.3 Environmental Monitoring

The Public Health Manager or officer responsible for waste management must develop or get the laboratory that does the testing of the groundwater to give a sampling procedure for collecting the samples that are extracted from the borehole on the site.

The testing results were superficially perused by a geohydrologist and the flowing high-level interpretation was given. It may be that the site has very saline water with high sulphates of which the nitrate and potassium are not high enough for it to be sewage and there is not high enough iron and manganese for it to be leachate.

During the next round of testing the laboratory should also test for the heavy metals: lead, chromium, and ammonia to test if its leachate. Leachate also has high chemical oxygen demand (COD) and this should also be included in the test.

If the testing indicates possible leachate contamination of the groundwater a geohydrologist must be appointed to do an investigation and make recommendations.

8.1.4 Compliance Auditing

8.1.4.1 Internal Auditing

The landfill manager must arrange bi-annual internal audits. The auditing can be done by the landfill manager or public health officer that does not work at the landfill. An example of an Audit Questionnaire is presented in Appendix B. An internal audit report must be written and non-compliances to the operating license or proper operations reported. The report must include recommendations for improvements and what actions must be taken. The auditor must assess if recommendations and actions from the previous audits have been implemented.

8.1.4.2 External Audits

The LA must arrange for a competent waste management or environmental specialist to conduct external audits annually or at least every two years. Recommendations from external audits must also be implemented and form part of the next internal audits.

8.2 Recycling and Waste Minimisation

Although there are six recyclers that collect recyclables from the landfill the recovery rate is only around one percent.

Waste separation at source is widely used method of promoting recycling as it negates the requirement of the recyclers at the landfill having to separate the comingled MSW and recyclables.

Separation at source for residential properties in Chobe is not viable or practical due to the low demand for recyclables and the cost of the infrastructure to do it. There are opportunities however for some separation to be done. Schools and commercial and industrial institutions can easily separate their dry and wet waste before delivery to the landfill. The area also has many guest houses and lodges where wet and dry waste can be sorted before it is brought to landfill. This will make it easier for the recyclers to collect the waste and the quality of the recyclables will be better.

Certain plastics such as PET (plastic cooldrink bottles) and HDPE are easily recyclable and there is a demand for these. Glass, aluminium and other scrap metal are also in demand as recyclables. The remote location of the locations means that the recyclables are far away from the markets that are either in the major centres or in South Africa. There is recycling taking place in Francistown, but it is approximately 500 km away. Francistown is also on the border of South Africa where larger recycling market exists.

If the recyclables are compacted it is easier to transport. Plastic bottles and cans are very large for the amount of recyclable material in the product. There are hand operated bottle and can crushers available that reduce the volume of the items significantly. Figure 22 shows examples that are available and relatively affordable.

The intuitions above could be encouraged to purchase these mechanisms and make it easier to recycle larger volumes.



Figure 22: Examples of Hand operated Bottle and can Crushers

The major problem with recycling in the region is the lack of awareness of the importance of recycling and methods that can be promoted such as mentioned above. Section 8.1.3 has further information on how to increase awareness regarding recycling.

8.3 Education and awareness

The LA presently does not have any formal community awareness campaigns that are directed at informing the general community with regards to waste management.

Recycling and waste minimisation initiatives, however, are not included in the normal service delivery and can only be effectively achieved with the co-operation of the residents.

It is therefore important that the community is made aware of initiatives, waste recycling activities and the advantages of waste minimisation and recycling by the LA. This can either be achieved by advertisements and notices in the local newspapers or pamphlets and flyers that can be dropped at households during collection for instance. Awareness Campaigns are crucial to make people aware of the Integrated Waste Management Plan of the LA. These awareness campaigns need to have the full support of the LA and other Government Departments. The campaigns will need to look at an integrated approach to community awareness; this can include one or more of the following campaigns:

- i. Awareness programs at schools, crèches and other institutions of learning,
- ii. Town and school clean up campaigns, with prizes for the most waste collected,
- iii. Encouraging schools to establish recycling centres and use as much of the waste for arts, crafts, gardening and functional gadgets.
- iv. Environmental Clubs.
- v. Community Awareness.

A brief description of each of the abovementioned campaigns follows:

Awareness programs at schools, crèches, and hostels

This will involve individual site visits to each school (can be done by environmental officials). Each school will be required to firstly arrange a clean-up campaign in and around the school. This waste is to be brought back to the school where it will be analysed. The students will be given the opportunity to find uses for each type of waste. They will also be shown examples of things made from waste. They will then be shown what to do with the waste. This could include crafts, swings, and sold as scrap for income, arts, handy tools, or blocks. The school will also be encouraged to establish a waste management system at the school. This could include a recycling centre and waste management policy.

The students will then be introduced to the competition. This will include the following:

- Drawing and colouring in competition which depicts a dirty and clean environment,
- Make any toy from waste,
- Make a recreational item from tyres,
- Make any handy item from a PET bottle,
- Make anything from tin,
- Make anything from paper or cardboard,

The LA can set aside a small budget for these initiatives and judging can be done by members of the community with prizes for the best categories.

Town and school clean up campaigns

Part of any waste program comes from the initial cleaning up of the town, school or village. Here the local schools and church groups can be involved. To make the campaign more appealing there should be some sort of incentive like prizes, snacks or cash incentives for the school's benefit. This can be coordinated with the school principals.

Part of the clean-up would include a presentation on what the clean-up is all about and why it is being done. The opportunity should be taken to encourage the setting up of small recycling centres. On completion of the clean up the children will return to the respective schools with the waste collected.

This waste will then be tipped out and analysed to see what types of waste was collected and why people threw it away in the first place. The students should then be encouraged to think of uses for the waste.

The LA will then take this waste away to the local waste disposal facility.

Encouraging schools to establish recycling centres and use as much of the waste for arts, crafts, gardening and functional gadgets.

Schools can be taught how to use their waste for the arts and crafts programs or to be used in the vegetable gardens or be used to retain erosion banks.

Environmental Clubs

The establishment of environmental youth clubs is seen as an integral part of the programme that has a potential to draw youth involvement into implementing environmental outreach programs. Ward Councillors could be encouraged to revive or set up environmental clubs. The LA must be involved in establishing these clubs.

Community Awareness



Figure 23: Waste Steel Drum with Litter Right Next To It (Google Street View)

The neighbouring schools may also be involved in school competitions and drama performances in order to strengthen public awareness campaigns. Although there will be efforts made to inform the community about waste management and the importance of the environment. In order to enhance the public environmental awareness campaigns a few suggestions are made below:

- The environmental Public Health Department should be engaged as their contribution could be enormous for the programme,
- The establishment of environmental youth clubs is seen as an integral part of the programme that has a potential to draw youth involvement into implementing environmental outreach programs,
- Community meetings, interaction through social media, door-to-door distribution of information are some of the tools that should be implemented to encourage the recycling activities,
- Local schools should be encouraged to participate in recycling activities and environmental education should be involved in school curriculum,
- Meeting with traditional leadership to encourage their ownership and communication of such initiatives into the rural areas,
- Publication of articles in local newspapers, printing of posters and information leaflets.

Figure 24 is an example of an information pamphlet produced by the South African Department of Environmental Affairs.

The LA should also begin a campaign of installing signage in public places to promote reducing littering that is still prevalent in the area.



WHAT ARE TYPES OF WASTE?

- BUILDING RUBBLE
- GARDEN REFUSE
- HOUSEHOLD WASTE
- ELECTRICAL EQUIPMENT
- INDUSTRIAL WASTE (CHEMICALS/ OIL DRUMS)
- OLD FURNITURE
- SCRAP CAR BODIES

WHO DUMPS WASTE?

- INDIVIDUALS AND HOUSEHOLDS
- WASTE TRANSPORTERS
- BUSINESSES AND INDUSTRIES
- BUILDERS AND DEMOLISHERS



WHAT CAN YOU RECYCLE?

- ✓ **PAPER** (CARDBOARD, NEWSPAPERS AND MAGAZINES)
- ✓ **GLASS** (CONTAINERS, JARS AND BOTTLES)
- ✓ **PLASTICS** (BAGS, CONTAINERS AND BOTTLES)
- ✓ **METAL** (FOOD AND DRINK CANS)
- ✓ **TETRA PAK** (FOIL-LINED CONTAINERS/CARTONS, E.G. MILK AND JUICE BOXES)
- ✓ **POLYSTYRENE** (WHITE TAKEAWAY CUPS AND FOOD CONTAINERS)

Remember to separate your waste at source!

Figure 24: Example of an Information Pamphlet Produced by the South African Department of Environmental Affairs

Workplace Environmental and Waste Management Awareness

The District Council can start awareness campaigns in the workplace. Some opportunities to communicate initiatives or good practice can be done as in the following examples:

- Posters can be placed on pinup boards in buildings (see Figure 25)
- Standard email signatures can be created for personnel with positive environmental messages,

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"Think Green! Please consider the environment before printing."

- Pamphlets can be circulated through internal mail with similar messages, and
- Meeting agendas could have a standing "waste management/environmental" message from the chairman at the start of each meeting.



Figure 25: Litter Awareness Posters

- Clean building initiatives could be started for example once a week personnel can do a lunchtime clean-up around their office building.

If the council employees lead by example this makes the implementation of community initiatives more impactful.

8.4 Byelaws

The LA must include waste management specific byelaws in the existing ones. To ensure the ability to enforce byelaws and issue fines or collection of tariffs the LA should with the relevant enforcement structure of the LA identify such byelaws.

To accomplish this the byelaws must include punitive measures for transgressions.

These byelaws should then be reviewed annually to assess efficacy and updated accordingly.

8.5 Sponsors

It is possible that sponsorships may be available to assist with training or awareness initiatives. Organisations such as NWDC, UNDP or (Japan International Cooperation Agency) JICA, DFID (UK) often have funds allocated for training or recycling initiatives in developing countries.

9. REVENUE AND COSTS OF EXISTING WASTE MANAGEMENT SYSTEM

9.1 Revenue

Funding for waste management is allocated through revenue support grants and development budget by the Ministry of Finance and Economic Development. The local authority collect additional revenue through tariffs that are collected from residents and businesses and from gate fees at disposal facilities.

Table 17 shows the budget for waste management.

Table 17: Waste Management Operations Budget

Item	Amount (BWP)
Personal Emoluments	866 785,60
Running Expenses	677 100,00
Establishment Expenses	29 587,20
Special	1 223 500,00
TOTAL	2 796 972,80

Table 18 shows the budget for the Landfill.

Table 18: Landfill Operations Budget

Item	Amount (BWP)
Personal emoluments	740 190,00
Running expenses	203 200,00
Establishment Expenses	32 230,00
Special	8 000,00
TOTAL	983 620,00

The following are the tariffs that are charged by the LA for waste management Collection and Disposal.

Table 19: Waste Management Tariffs

Type	Charge (BWP)	
	Council	Self
Waste collection		
Residential	10	20/load(>100kg)
Commercial/Institution		
Category 1	50	30/load
Category 2	150	30/load
Category 3	200	30/load
Category 4	300	30/load

Type	Charge (BWP)	
Category 5	600/annum	30/load
Category 6	1000	30/load
Garden/Clean soil/Domestic rubble	100/load	Free
Commercial Builders rubble	200/load	Free
Scrap metal	100/load	0.1/kg
Clinical Waste/Confidential waste	20/kg	10/kg
Condemned/Surrendered food		50/load
Skip Hire	200	
Recycling		
Landfill permit Fee	500/annum	
Tyres	0.3/kg	
Metal/cans	0.2/kg	
Box/Plastic/Glass	0.1/kg	
Wood	0.05/kg	
Pest Control		
Cockroaches		
Residential	30/room	
Commercial/ institution	80/room	
Rats/ Bats		
Residential	50/service	
Commercial/ institution	150/service	

9.1.1 Waste Cost Recovery Mechanisms

There are approximately 4,600 households that are served by the Kasane landfill. Although not every household was approached during the public participation exercise, the sample is considered to be representative of the area. During the survey approximately 50% of household indicated that they do not pay for the waste collection service however, more than 90% can afford it.

This would indicate that if the LA enforced the waste collection service at a cost of BWP 10.00 per household and additional BWP 276,000 would be collected per annum.

The LA must plan a drive to collect tariffs from residents. It is preferable that this is initially not done by law enforcement but rather through educating residents on the importance of responsible waste management.

9.2 Capital and Operational Costs

9.2.1 Planned Capital Costs

Except for construction of a recycling shed and purchasing litter fencing there is currently no planned further capital expenditure.

9.2.2 Required Capital Expenditure

Table 20 gives the costs of replacing the current collection and landfill fleet.

Table 20: Collection and Landfill Vehicle Replacement Costs

	Equipment	Time Frame	Cost in BWP
Replace Collection Equipment	Replace Refuse Compactor Trucks	Replace 4 In the short term	12,931,600
	Single Cab Vehicle	Replace 1 In the short term	300,000
	Double Cab Vehicle	Replace 1 In the short term	400,000
	Clinical Vehicle	Replace 1 In the short term	400,000
	Tipper Truck	Replace 1 In the short term	1,700,000
	Water Tanker (8Kl)	Replace 2 In the short term	3,300,000
	Skip Truck	Replace 2 In the short term	2,694,604
	Waste Receptacles required for collection	Purchase 80 Replace 2 In the short term	468,368
	TOTAL		21,726,204
Replace Landfill Fleet and Equipment	Landfill Compactor	Replace 1 In the short term	3 200 000
	Water Tanker (8Kl)	Replace 1 In the short term	1 459 000
	Front End Loader	Replace 1 In the short term	3 500 000
	TLB	Replace 1 In the short term	890 000
		TOTAL	

Although the fleet does need replacing it is suggested that the exercise is phased as described in Section 8 above.

10. WASTE MANAGEMENT STRATEGY

10.1 Waste Management Strategic Objectives

10.2 Strategic Objectives

The status quo of waste management in Kasane and Kazungula as described above and the problems associated with waste management can only be remedied with an integrated approach to the problem.

The strategic objectives set out below must be planned, implemented, monitored and remedied if these objectives are not complied with.

The timeframes are as follows:

- Short Term 0 to 1 year
- Medium Term 1 to 3 years
- Long Term 3 to 5 years

10.2.1 Waste Management Policy and Oversight

Objective	Responsible Party	Action	Cost in BWP	Timeframe
Informed political and strategic management regarding waste and the negative environmental and other impacts of poor management	Chobe District Council	Waste Management training for Councillors and Senior Management regarding environmental impacts and cost cycle of waste management if not planned properly	For a Waste Specialist to develop training material and do a 1-day course in Kasane if the LA provides the venue the cost, including disbursements will be: P 22,000	Short Term
Informed Public Health Managers regarding Management of waste	Chobe District Council	Train functional managers in the public health department on proper waste management from generation through collection, transportation recycling and disposal	For a Waste Specialist to develop training material and do a 2-day course in Kasane if the LA provides the venue the cost will be ,including disbursements will be: P 25,000	
Competent Waste Management Personnel in Public Health Department	Chobe District Council	Dedicated Waste Manager in charge of Collections and Disposal Senior Officer Level	P 7,200/m	
Effective law enforcement	Chobe District Council	Develop specific byelaws regarding waste management. This should be done by a consultation process between the department responsible for legal matters and the waste collection and disposal structures	N/A	Medium to Long term

10.2.2 Waste Collection Objectives and Actions

Objective	Responsible Party	Action	Cost in BWP	Timeframe
Competent Human Resources	Chobe District Council	Appoint Qualified Personnel i. Waste Collection Officer ii. Law Enforcement Officers	P6,200/m P5,300/m	Short Term
Vehicle replacement plan	Chobe District council	Appoint Third party technical expert to audit current condition of vehicles and report on what is worth fixing and when vehicles will need to be replaced.	Assuming this capability is available in Gaborone the cost of the exercise should be in the region of: P 17,000	Short Term
New Collection Equipment	Chobe District Council	New equipment: i. 4 Compactor Trucks, ii. Single cab utility vehicle iii. Double cab utility vehicle iv. Clinical collection vehicle v. Tipper truck	21,726,204	

10.2.3 Waste Disposal Objectives and Actions

Table 21: Strategic objectives Kasane Disposal

Objective	Responsible Party	Action	Cost in BWP	Timeframe
Human Resources	Chobe District Council	Appoint Qualified landfill manager, If current incumbent is already appointed, send individual for training or skills development at properly managed landfill (Gamodubu for instance). Possible job shadowing for individual in RSA (2 weeks) Appoint staff required for proper site operation: i. 1 Incinerator Operator, ii. 1 Weighbridge Operator,	P26,500 P4,700/month P4,700/month	
Landfill Infrastructure	Chobe District Council	New infrastructure: i. Construct covered recycling storage area, ii. Construct concrete slab with drain and catch pit at the oil receiving tank, iii. Construct road around weighbridge, iv. Construct side wall to height of weighbridge surface to the north of the weighbridge for safety and to prevent material entering under bridge, v. Install new signage at entrance, wheel wash bay and oil receiving area, vi. Construct 500m Berm or Construction Material TOTAL vii. Install 700m Concrete Palisade Fence	P13,500 P3,500 P5,500 P1,750 P11,500 P405,000 <u>P1,080,000</u> P1,485,000 P650,000	Short Term Short Term Short Term Short Term Short Term Medium to Long Term
		Move Available Incinerator to the Landfill site		Short Term

Objective	Responsible Party	Action	Cost in BWP	Timeframe
Landfill Infrastructure Maintenance	Chobe District Council	Existing infrastructure <ul style="list-style-type: none"> i. Repair electric fence around landfill ii. Clean and paint storage cages at office area, iii. Repair wash bay to drain to catch pit, iv. Repair road surfaces and install kerbing to sides of roadways. 		Short Term
New Landfill Equipment	Chobe District Council	Purchase the following Equipment <ul style="list-style-type: none"> i. Landfill compactor, ii. 1 Waster Browsers, iii. Front End Loader, iv. TLB, v. Incinerator (if not available from village) 		Short to Long Term
Existing Landfill Equipment	Chobe District Council	Maintenance <ul style="list-style-type: none"> i. Plan maintenance in advance, ii. Assign responsible person per equipment 	N/A	Short Term
Proper Landfill Operation	Landfill Manager Operators Laborers	Develop specific landfill operational plan examples of activities for operations: Housekeeping <ul style="list-style-type: none"> i. Clear brush vegetation around installations to reduce risk of fire, ii. Clean Littre, iii. Daily Cover, iv. Working Face Management, v. Disposal truck routing, vi. Dust control Equipment: <ul style="list-style-type: none"> i. Inspections, <ul style="list-style-type: none"> ▫ Tyre pressure, ▫ Oil levels, ▫ Hydraulic fluid levels, ▫ Coolant levels, ▫ Wear ii. Washing, Implement Operations Plan <ul style="list-style-type: none"> i. Implement Landfill Operations Guidelines 3rd Edition ISWA 2019¹² 	N/A	Short Term
Continued Assessment	Landfill Manager	Internal Audits <ul style="list-style-type: none"> ▫ The landfill Manager must arrange for internal audits every 6 months External Audits <ul style="list-style-type: none"> ▫ The Landfill Manager must arrange for external audits at least every 2 years 	If the service is provided from Gaborone or Francistown the cost will be approximately P17,000	Short to Medium Term

1. ¹² <https://www.iswa.org/home/news/news-detail/browse/12/article/download-the-3rd-landfill-operations-guidelines/109/>

Objective	Responsible Party	Action	Cost in BWP	Timeframe
Airspace Management and planning	Chobe District Council	i. The LA must appoint a qualified land surveyor to undertake a topographical survey of the waste body.	P19,500	Short to Medium Term
		ii. A qualified Civil Engineer or GIS specialist must compare the existing site to the design capacity and report on the available airspace	P5,000	
Fire Fighting	Chobe District Council	Install new Firefighting Equipment		Short to Medium Term
		□ 15 Extinguishers with Backing Boards	P5,000	
		□ 3 Hose Reels	P18,000	
		□ 3 Fire hydrants with standpipe and coupling, Off the ground box, 3 lengths of hose and a pipe branch	P17,500	
		400m of watermain for hydrants delivered and installed	P190,000	
		TOTAL	P230,500	
Environmental Management	Environmental Health officer	An Environmental Management Plan must be developed for the landfill site, the plan must include: <ul style="list-style-type: none"> i. Potential impact categories, ii. Source, iii. Control Measures, iv. Responsible Party, v. Scheduling, vi. Performance indicators See example in Appendix C	N/A	Short Term
Operational compliance	Landfill Manager	The Landfill Manager must setup an internal auditing system that must be done bi-annually. The internal audits must be based on a standard questionnaire that is developed for the landfill from the licensing conditions and operations and Environmental Management Plan:	N/A	Short Term
Environmental monitoring	Chobe District Council	i. Install available incinerator at incinerator building with in-stack flue gas monitoring,		P 22,500
		ii. Appoint Geohydrologist to develop sampling procedure, show official how to sample and do groundwater contamination investigation at landfill,		
		iii. Based on recommendations install an additional monitoring points if necessary.	P40,000 to P50,000	

10.2.4 Education and Awareness Programs

Objective	Responsible Party	Action	Cost in BWP	Timeframe
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Create Awareness of responsible waste management for employees of the LA	Chobe District Council Senior Public Health Officer	Create standard email templates that highlight recycling after the signature, Send pamphlets to personnel through internal mail where workplace waste disposal good practice is discussed. Put posters on pinup boards at council buildings with calls to stop littering or try to avoid single use plastic	A small budget of around P5,000 as a kick-off	Short to Long Term
Create Awareness of responsible waste management in the community	Chobe District Council	Public Awareness Campaigns, schools, social media , local community forums etc.	Allow a budget of between P15,000 and 35,000 per annum with annual review	Short to Medium Term

11. CONCLUSIONS AND RECOMMENDATIONS

11.1 Conclusions And Recommendations

11.1.1 Conclusions

The importance of proper waste management and the negative effects that inadequate waste management has on the environment and also on other aspects such as tourism for instance is not understood at a District or Local Council level. This lack of knowledge leads to ineffective oversight and allocation of resources.

There is a shortage of personnel in both collection and disposal or the personnel that are employed are not sufficiently trained.

Waste management equipment is outdated and constantly not in service due to breakdowns. This is a result of poor maintenance and a lack of inhouse capacity and capability to maintain the equipment.

The LA has equipment that is not being used due to a lack of operators that are trained to use the equipment.

Waste disposal is generally poor and the infrastructure at the landfill site has deteriorated over time. The site is not properly managed due to a lack of competency rather than intent.

The lack of community awareness and understanding regarding waste management leads to problems such as littering and there is not a culture of preventing the generation of or avoiding waste.

The local byelaws only refer to the Waste Management Act and this makes any enforcement of payment for collection or aspects such as littering problematic.

11.1.2 Recommendations

Service providers must be appointed to do training with Councillors and senior management on the importance of waste management and the required oversight involved.

Additional personnel must be employed to occupy the vacant positions or to fill new positions that are required.

Current serviceability and condition of equipment must be assessed and based on the assessment a phased replacement plan must be drawn up.

Operations at the landfill must be improved, a generic waste management operations plan is available (<https://www.iswa.org/home/news/news-detail/article/download-the-3rd-landfill-operations-guidelines/109/>). Requirements must be included in operations that are specific to the site. This is the responsibility of the landfill manager.

Community awareness must be implemented to promote the waste hierarchy and create general mindfulness regarding waste.

12. REFERENCES

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12. Implement Landfill Operations Guidelines 3rd Edition ISWA 2019

Appendix A. Draft Environmental Management Plan Example

Potential Impact categories	Potential Locations	Source	Control measures	Monitoring Actions and methods	Responsibility Person	Scheduling	Performance Indicator
Landfill Site	Waste Acceptance		Only non-hazardous Waste can be accepted at the Landfill site. If waste is considered hazardous it must be sent for disposal or treatment by specialized 3 rd party	A controlled access gate where waste is screened before allowing access.	<ul style="list-style-type: none"> Gate Security Waste Transporter 	As needed	
			Catch screens for windblown litter that is caught in perimeter fences or blown outside the boundaries of the site	Visual inspection of working face and surrounding fencing	<ul style="list-style-type: none"> Landfill Manager 	Continually	Nuisance complaints
			Waste must be placed compacted and covered in one working shift and must not be left open overnight.	Landfill operations plan.	<ul style="list-style-type: none"> Landfill equipment operators 	Continually	
	Groundwater		Construct cut-off berms and drainage channels for effective runoff management during rainfall event.	Newly placed waste must be covered during rainfall events	<ul style="list-style-type: none"> Landfill operator 	Daily	
		Lack of protection	Damage to containment barrier. Containment barriers such as Geosynthetic Clay Liner(GCL) and Membranes must be protected from mechanical damage by workers and waste management equipment like trucks, dumpers or compactors	Visible damage inspections of linings system and monitoring of groundwater.	<ul style="list-style-type: none"> Landfill operator Landfill labourers 	Daily	Groundwater contamination
	Roads		Damage to containment barrier from road construction to waste body or working face.	Visible damage inspections of linings system and monitoring of groundwater	<ul style="list-style-type: none"> Landfill operator Waste transporters 	On Going	
	Fire and Explosion	Anaerobic digestion	Many waste types are flammable and smocking or open fire are prohibited at the working face of the waste body. Fire extinguishers must be made available during waste disposal activities.	Continues visual monitoring for smoke or signs of fire. A firebreak must be maintained around the landfill site	<ul style="list-style-type: none"> Landfill operator Landfill labourers 	Continually	

Potential Impact categories	Potential Locations	Source	Control measures	Monitoring Actions and methods	Responsibility Person	Scheduling	Performance Indicator
			The placement of high volumes of organic matter in the waste body must be managed and mixing of waste can lessen concentration of organics .	Landfill gas testing must take place from time to time and personnel working on the landfill must be trained in the hazards of explosive landfill gas.	<ul style="list-style-type: none"> Landfill operator 	Continually	
	Dust		Road surfaces, cover material stockpiles and covered areas of the waste body must be watered	Air emissions monitoring includes dust fallout can be done.	<ul style="list-style-type: none"> Landfill operator 	Based on ongoing complaints	Dust fall out
Noise	Disturbance of Communities		Due to nature of the operation of the site the noise is considered to be significant and unavoidable during daytime hours.	Monitor any complaints from neighbouring communities.	<ul style="list-style-type: none"> Operators 	Daily	Nuisance Complaints
			Vehicles must be properly maintained, and this includes repair to any broken exhaust systems to ensure minimisation of noise.	Monitor any complaints from neighbouring communities.	<ul style="list-style-type: none"> Operators 	Continually	Nuisance Complaints
	Personal Safety		Hearing protection will be required for all personnel working in areas where excessive noise is generated.	Method Statements for activities will include guidelines for hearing protection equipment	<ul style="list-style-type: none"> 	Always	
Air Quality	Dust		Use water truck and/or sprinklers as necessary to suppress dust on the site.	Dust suppression by Water trucks. Daily monitoring of dust fall out	<ul style="list-style-type: none"> Landfill Operators 	Continually	Dust Fall-out above limit
			Water suppression measures must be implemented in extreme dry, high dust situations.	Dust suppression by Water trucks.	<ul style="list-style-type: none"> Operators 		

Potential Impact categories	Potential Locations	Source	Control measures	Monitoring Actions and methods	Responsibility Person	Scheduling	Performance Indicator
	Emissions		Visually assess dust and if necessary, install deposition gauges at selected sites.	Implement and enforce the Air Quality Plan.	<ul style="list-style-type: none"> Landfill Operators 	Continually	Dust Fall-out above limit
	Vehicles		All vehicles will be kept in good serviceable order to ensure limiting emissions.	Weekly vehicle inspection.	<ul style="list-style-type: none"> Maintenance Manager 	Continually	
			The diesel engine will be maintained to ensure no excessive emissions. Exhaust gasses will be monitored.	Implement and enforce the Air Quality Plan	<ul style="list-style-type: none"> Environmental Manager Maintenance Manager 	Continually	

Appendix B. Draft Audit Questionnaire

ACTIVITY		SCORE Poor (1) to Good (5)				
1.	Signage & Access	1	2	3	4	5
1.1	Signage & Access					
1.2	All weather roads					
2.	Controls					
2.1	Waste acceptance procedure					
2.2	Fencing					
2.3	Control of vehicle access					
2.4	Site security					
2.5	Operating plan					
2.6	Emergency response action plan					
2.7	Waste load allocations					
3.	Resources & Infrastructure					
3.1	Weighbridge					
3.2	Collection of waste disposal tariffs					
3.3	Site Office					
3.4	Adequate plant and equipment					
3.5	Responsible person					
3.6	Sufficient qualified staff					
4.	Landfill Operation					
4.1	Compaction of waste					
4.2	Daily cover					
4.3	Two week's cell or trench capacity					
4.4	Protection of unsafe excavations					
4.5	One week's wet weather cell capacity					
4.6	Immediate covering of putrescibles					
4.7	End-tipping prohibited					
4.8	Three-day stockpile of cover					
4.9	Final cover					
4.10	Any reclamation operation formalised in Operating Plan					
4.11	Registration of reclaimers					
4.12	Protection of reclaimers					
4.13	PPE					
4.14	Control of nuisances					
4.15	Is Waste burning prohibited					
4.16	Draining water away from the waste					
4.17	Contamination run-off contained					
4.18	Leachate contained					
4.19	Stormwater diversion measures					

ACTIVITY		SCORE Poor (1) to Good (5)				
4.20	Grading cover/avoiding ponding					
4.21	General site maintenance					
4.26.	Rehabilitation and vegetation					
5.	Monitoring & Record Keeping					
5.1	Responsible person					
5.2	Landfill Monitoring Committee (regular stakeholder meetings)					
5.3	Conduct external audits					
5.4	Appropriate records and data collection					
5.5	Record deposition rate					
5.6	Waste stream records					
5.7	Landfill volume surveys					
5.8	Collect climatic statistics					
5.9	Water quality monitoring					
5.10	Air quality monitoring					
5.11	Monitoring of progressively rehabilitated areas (special consideration)					
5.12	Ongoing maintenance					

Appendix C. Public Participation Questionnaire

Urban/Semi-Urban/Village	Question			
1. Demographics	1.1 House number / GPS coordinates			
	1.2 Income in BWP			
	1.3 Income Category (Low, Medium or High) Per Month			
	<table border="0"> <tr> <td style="padding-right: 20px;">L</td> <td style="padding-right: 20px;">Low</td> <td>P0 - P5,000</td> </tr> </table>	L	Low	P0 - P5,000
	L	Low	P0 - P5,000	
	<table border="0"> <tr> <td style="padding-right: 20px;">M</td> <td style="padding-right: 20px;">Medium</td> <td>P5,001 - P15,000</td> </tr> </table>	M	Medium	P5,001 - P15,000
	M	Medium	P5,001 - P15,000	
	<table border="0"> <tr> <td style="padding-right: 20px;">H</td> <td style="padding-right: 20px;">High -</td> <td>Above P15,000</td> </tr> </table>	H	High -	Above P15,000
	H	High -	Above P15,000	
	1.4 Job category			
1.5 Total Number of People in the House				
1.6 Vulnerability				
1.7 Age				
1.8 Tenants				
1.9 Monthly expenses (pula)				
2. Waste Collection	2.1 Cost			
	<table border="0"> <tr> <td style="padding-right: 20px;">2.1.1</td> <td>Waste monthly cost (Pula)</td> </tr> </table>	2.1.1	Waste monthly cost (Pula)	
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	<table border="0"> <tr> <td style="padding-right: 20px;">2.1.2</td> <td>Electricity</td> </tr> </table>	2.1.2	Electricity	
	2.1.2	Electricity		
	<table border="0"> <tr> <td style="padding-right: 20px;">2.1.3</td> <td>Water</td> </tr> </table>	2.1.3	Water	
	2.1.3	Water		
	2.2 Who collects the Waste			
	2.3 Method of Collection			
	2.4 Do you pay for the collection			
2.5 What is the collection Frequency				
2.6 Willingness to pay				
<table border="0"> <tr> <td style="padding-right: 20px;">2.6.1</td> <td>Can you afford the current service</td> </tr> </table>	2.6.1	Can you afford the current service		
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<table border="0"> <tr> <td style="padding-right: 20px;">2.6.2</td> <td>If service improved, would you be willing/able to pay more</td> </tr> </table>	2.6.2	If service improved, would you be willing/able to pay more		
2.6.2	If service improved, would you be willing/able to pay more			
2.7 What is your waste collection method preference				
2.8 Waste Storage Method (Plastic Bins, Plastic Bags or Steel Drum)				
3. Collection Service Level	3.1 Is the waste collection service provider reliable			
	3.2 Are their collection vehicles in good condition			

	3.3 Does the LA collect waste during rainy seasons or only during dry seasons? (Is there a difference in waste collection during the wet and dry seasons?)
	3.4 How would you rate the service on a scale of 1 to 10 with 1 being poor and 10 being excellent how would you rate them?
	3.5 What are your concerns when it comes to waste collection/management in their area?
	3.6 Anything other issues or suggestions for improvement you would like to add
4. Waste Quantity [%]	4.1 Food
	4.2 Garden waste
	4.3 Plastic (bottles, packaging, bags etc.)
	4.4 Paper / cardboard
	4.5 Glass
	4.6 Wood
	4.7 Metal
	4.8 Textiles
	4.9 Electricals (mobile phones, tvs, etc.)
	Oil