

WASTE MANAGEMENT PLAN

AMHARA IAIP AND RTC

Report Produced by:
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DATE: DECEMBER 2017



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1 INTRODUCTION

The Waste Management Plan (WMP) addresses management of all solid and liquid refuse, including hazardous and non-hazardous waste, produced as a result of Project activities within the Amhara IAIP and RTC sites.

The WMP covers the construction and operational phases. This report constitutes the initial draft which will require amendment and updating as enterprises begin development and operation within the IAIP and RTC.

2 PURPOSE

The WMP aims to provide guidelines on waste reduction, segregation, collection and disposal practices in accordance with international best practices, to avoid deterioration of the natural environment and negative impacts on the health and safety of communities in the Project Area.

The Project is committed to apply the waste hierarchy and will seek to be a zero waste discharge facility. This plan is the primary tool to guide employees towards waste management.

3 WASTE MANAGEMENT OPTIONS - WASTE HIERARCHY

The waste hierarchy presents waste management stages commencing with the most preferable option to the least preferable option. Waste prevention is the most preferred option, followed by reuse, recycling, recovery including energy recovery and as the last option is safe disposal, see **Figure 1**.

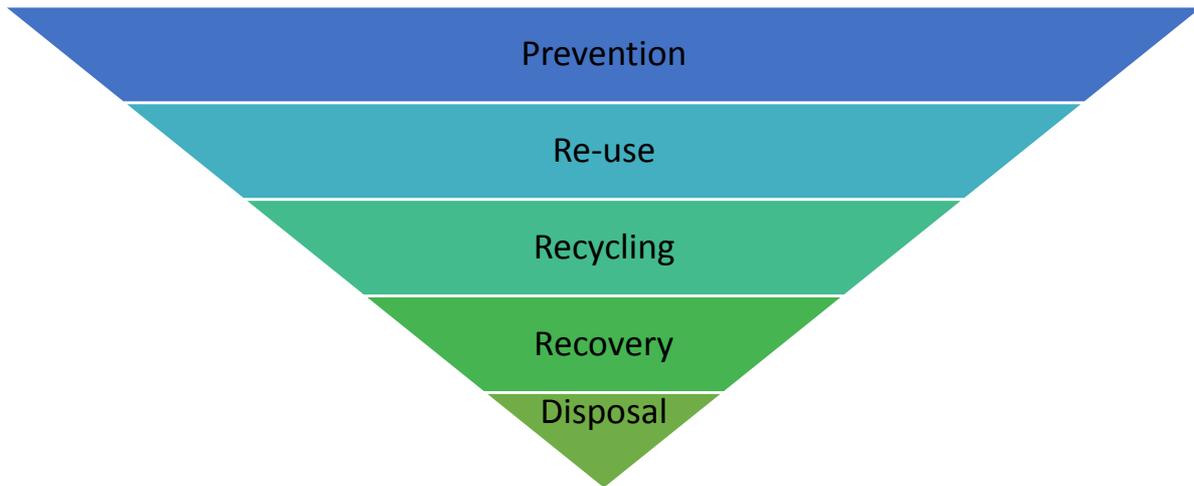


Figure 1: Stages of the Waste Hierarchy

These stages are described in more detail below:

PREVENTION

Enterprises should be required to strictly manage purchasing of raw materials in order to ensure there is minimal wastage. The focus is to prevent raw materials, ingredients and products from becoming waste in the first place. Any surplus raw materials or produce not meeting exporting standards or products that have been sent back after being exported owing to defects should be reduced by redistributing these products at organised market events occurring within the Park or RTC twice annually, donate to charity lawfully within the country or sending for animal feed. This is in line with the requirements set out within the Industrial Park Proclamation No. 886/2015¹.

¹ Refer to Article 19(11)

Enterprises should be committed to avoiding the generation of waste and not using hazardous materials. Where the use of hazardous materials is unavoidable, efforts should be made to identify replacement materials that are non-hazardous through continued research and development.

RE-USE

Enterprises should be required to prepare a maintenance management plan which seeks to ensure that all equipment is regularly checked and maintained and refurbished or repaired. In addition, Enterprises should seek to sell and buy used items, donating them for free or exchanging them.

RECYCLING

Enterprises should seek to turn waste into a new substance or product, such as composting of organic wastes to a standard that meets quality controls. This compost could be sold or given to farmers outside the boundary of the sites to facilitate improvements in soil conditions and hence their production levels.

RECOVERY

Recovery of waste is usually most successful when done in bulk. Therefore, a centralised recovery facility is preferable. Forms of recovery include anaerobic digestion, incineration with energy recovery, gasification and pyrolysis which produce energy (fuels, heat and power) and materials from waste. It is recommended that the solid waste management system be modified and improved to make it compatible with the requirements of the proposed bio-methanation technology.

DISPOSAL

Disposal is deemed the last resort and must occur in an environmentally responsible manner. Disposal results in waste going to landfill or to incineration without energy recovery and is the least preferred environmental option. However when wastes must go for disposal this must occur at a suitably designed sanitary waste disposal site.

4 WASTE CATEGORIES GENERATED BY THE IAIP AND RTC SITE

Solid waste generation in the Amhara IAIP and RTC will generally include domestic waste, commercial waste, construction and demolition debris, sanitation residue and waste from streets. These wastes will be in solid or semi-solid form and will potentially include very low quantities of industrial hazardous wastes and bio-medical waste (from the polyclinic). All industrial hazardous waste and biomedical waste must be disposed of properly by the respective industries and cannot be included in the site wide waste management system. Solid waste generation in the Amhara IAIP and RTC will include domestic waste, commercial waste construction and demolition debris, sanitation residue and waste from the streets. The main waste categories anticipated are:

- Biodegradable waste (food and kitchen waste, green waste (vegetables, flowers, leaves, fruits) etc.;
- Recyclable material (paper, glass, bottles, cans, metals, certain plastics, etc.); and
- Inert waste (construction and demolition waste, dirt, rocks, street sweeping, drain silt, debris, etc.)

The sources of waste and waste generators and the anticipated content of the solid waste generated are presented in **Table 1** below.

Table 1: Sources of waste, waste generators and content

Source	Typical waste generators	Solid waste content
Industrial	Process by industries and employees	Food wastes, paper, cardboard, plastics, ashes, special wastes (e.g. bulky items, consumer electronics, batteries, oil, tyres) and limited industrial hazardous wastes.

Source	Typical waste generators	Solid waste content
Residential	Dwelling units	Food wastes, paper, cardboard, plastics, textiles, leather, yard wastes, wood, glass, metals, ashes, special wastes (e.g. consumer electronics, batteries, oil, tyres) and limited household hazardous wastes. Sewage waste.
Commercial	Stores, hotels, restaurants, markets, office buildings	Paper, cardboard, plastics, wood, food wastes, glass, metals, special wastes, hazardous wastes
Institutional	Schools, hospitals, government centres	Paper, cardboard, plastics, wood, food wastes, glass, metals, special wastes, hazardous wastes
Construction and demolition	New construction sites, road repair, renovation sites, demolition of buildings	Wood, steel, concrete, rubble, dirt etc.
Municipal services	Street cleaning, landscaping parks and other recreational areas, water and waste water treatment plants	Street sweepings, drain silt, landscape and tree trimmings, general wastes from parks and other recreational areas, sludge.

The estimated solid waste generation volumes have been provided by MACE within the Solid Waste Management Design and Estimate IAIP Bure Report (October 2017) and are presented in Table.

Total Area									
SI No.	Description	Hectares	Acres	Percentage	Population	Per Capita SWM generation kg/ha or gm/capita	SWM generation in TPD	Biodegradation in TPD	Non Biodegradable/Recycle waste in TPD
1	Industries	169.00	417.609	65%	212820.00	200	4.364	3.491	0.873
2	Amenities	19.40	47.933	7%	3499.60	100	0.350	0.280	0.070
3	Residential	2.04	5.035	1%	1098.00	450	0.494	0.395	0.099
4	Road	26.02	64.301	10%	0	10	0.260	0.208	0.052
5	Utilities	10.77	26.602	4%	38.00	100	0.004	0.003	0.001
6	Park, greenery & existing stream area	30.43	75.186	12%	0	30	0.913	0.731	0.183
	Total area	260.56	643.85	100%	26455.60		6.385	5.108	1.277

5 WASTE TREATMENT OPTIONS

The primary options for the treatment of solid waste include, in order of environmental benefit:

- 1 Anaerobic Digestion;
- 2 Composting (windrow, aerated static pile, in-vessel and vermi-composting);
- 3 Incineration with or without energy recovery;
- 4 Pyrolysis and gasification;
- 5 Plasma pyrolysis and palletisation; and
- 6 Reuse Derived Fuel (RDF) for mixture waste.

Since the nature of waste envisaged in this park is wet, bioconversion methodologies are considered the preferred technology.

6 EXISTING AND PROPOSED WASTE MANAGEMENT INFRASTRUCTURE

In the Bure and Mota towns, there are no organised and advanced waste management systems such as collection, transport and disposal.

The current municipal waste management practices in Bure town are not formally organised. According to the Beautification and Sanitation Office, the town lacks solid and liquid waste collection and disposal facilities. Solid waste from Bure Town is largely managed by each independent household actively removing their own waste. There are some industrious citizens that have begun waste collection from commercial establishments using horse carts. To date, Bure Town has no designated dumpsite for the solid and liquid waste collected. Solid waste disposed is illegally dumped on open ground. The municipality assists residents by contracting a liquid waste vacuum truck from Bahir Dar to empty septic tanks. Residents requiring the service of the vacuum truck must formally register with the municipality and make payment to the municipality for this service. However it is according to the Beautification and Sanitation Office, the sewage collected is disposed of into farmlands whose owners have agreed to receive such in order to fertilise their farmland.

Mota has similar waste management practices as Bure with no formal waste management facility or landfill in close proximity to the town. The waste management infrastructure proposed within the Amhara IAIP and RTC are detailed below:

AMHARA IAIP

A Sewage Treatment Plant (STP & CETP) and common Effluent Treatment Plant is proposed to be located in the most southwest corner of the IAIP in close proximity Solid Waste Management (SWM) area. The Solid Waste Management area will be located on the southern boundary, two plots to the east of the STP & CETP along the compound southern boundary line. The SWM area will be used for receipt of primary collection waste. Here the waste will be segregated and prepared for onward transport to the recycling area and any leachate to the sewage treatment plant.

Landfills are limited in Ethiopia and Bure town has no suitably designed and controlled landfill site. The Bure Municipality intends to designate a landfill site to be located on the southern outskirts of the Bure Town. It is reported that preparations are underway to handover the designated landfill site and to fence it in the current fiscal year. In addition, in an effort to assist in formalizing the waste collection practices of the town, the Bure Municipality has purchased two tipper rickshaws (three wheeler). The tipper rickshaws are especially designed for solid waste collection and are expected to start operation in the current year.

There are no sanitary landfills in the area that can receive municipal solid wastes collected from the towns. Larger towns, such as Fenoteselam and Injibara that are located about 25km and 50km south and north of Bure town respectively, do not have properly designed and operated sanitary landfill sites. These towns dump their solid wastes in pit wholes dug for that purpose and bury/cover it with soil material when filled.

Since there is no well managed sanitary landfill site in close proximity to the Park any residual waste, such as hazardous industrial waste and biomedical waste, which will require safe disposal, must be

transported the necessary distance to ensure disposal occurs in an environmentally responsible manner. A sanitary landfill site must be used for the disposal of hazardous waste.

AMHARA RTC

Within the masterplan there is an area allocated for solid waste management in the north-western corner of the site. Adjacent, and to the south, is the Sewage Treatment Plant and common Effluent Treatment Plant.

Mota town has no designated and controlled landfill site. Therefore, since there is no well managed sanitary landfill site in close proximity to the RTC any residual waste, such as hazardous waste which will require safe disposal, must be transported the necessary distance to ensure disposal occurs in an environmentally responsible manner. A sanitary landfill site must be used for the disposal of hazardous waste.

7 SOLID WASTE MANAGEMENT AT THE AMHARA IAIP AND RTC

All enterprises within the IAIP and RTC will be required to segregate waste at source to ensure the value of the wastes are optimised through recovery, reuse and recycling. By providing an enabling environment the success rate of correct waste practices being implemented are increased.

Segregation should be by generators and into three main waste streams:

- Wet (biodegradable);
- Dry (plastic, paper, metal and wood); and
- Domestic hazardous wastes (diapers, napkins, empty containers of cleaning agents, mosquito repellents etc.).

Collection of the segregated waste is to be undertaken by an authorised waste collector. As a minimum wet and dry wastes should be segregated (2-bin system) by the waste generators, see **Figure 2** below. Source segregation of waste optimises waste processing and treatment technologies. The bio-degradable waste should be processed, treated and disposed of through composting or bio-methanation within the premises as far as possible. The development is required to be a zero waste facility and therefore all residual waste from the bio-methanation or composting will need to be managed on the IAIP site. Plots or sheds within the IAIP are to be designated for recovery and recycling facilities.



Figure 2: Example of waste separate of inorganic and organic wastes at source

A bio-methanation facility is being proposed at the IAIP for the treatment of the wet waste component generated at the IAIP. This involves the anaerobic decomposition of wet organic wastes to produce a methane-rich biogas fuel and a small amount of residual sludge that can be used for making enriching compost. It is currently proposed that the biogas will supply fuel to a 25KVA capacity engine which will be used for generating power from the biogas produced. The generated power can be used for

internal electrification and street lighting. It is also possible to consider using the biogas fuel to fuel transport trucks and waste trucks associated with the IAIP and RTC sites.

Anaerobic digestion is best suited to the treatment of wet organic feed stocks such as high moisture agricultural biomass, food waste, and animal wastes including manure and domestic sewage. A

Construction and demolition waste should be stored separately. Opportunities to repurpose this waste as secondary aggregate to the construction industry should be investigated to ensure this waste is either utilised on the IAIP site or is sold as a product to the construction industry. No construction or demolition waste should be disposed of to landfill.

No hazardous wastes shall be permitted to be disposed of outside the boundary of the IAIP or RTC unless being transported to a sanitary landfill. The IPDC must place the responsibility of safe disposal of hazardous waste on the generator. It will be the generators responsibility to ensure that the waste collector which will be transporting the waste for disposal has obtained a permit from the Urban Administration to do so in terms of Article 4(1) of the 'Solid Waste Management Proclamation 513/2007. In addition, the Generator will need to provide evidence in writing from the receiving disposal site of its capacity to recycle or dispose of the waste in an environmentally sound manner (Article 6(3)). Proof of safe disposal should be provided to the IPDC, such as a waste disposal ticket issued and date stamped by the sanitary landfill. This waste stream is anticipated to be small, limited to cleaning materials and small quantities of bio-medical waste since most of the processing to be undertaken on site is for the food industry and therefore hazardous process materials should be limited.

Within the Park there will be primary collection of waste from the industries, households, markets and other commercial establishments. This waste will be taken directly to the treatment site. Primary collection will occur by either 'door to door' collection using segregated bins or containers which will be placed on the streets for collection. This waste will be taken to a solid waste intermediate storage facility. The use of an intermediate site allows for the optimisation of transport devices and manpower which in addition allows for timely collection of waste from source and onward treatment. Secondary transportation occurs from the storage area to the final destination of the waste, wet waste will go to the bio-methanation plant and dry wastes will go to the recycling depot.

The dry waste such as paper and plastic and cardboard and glass are to be recycled. The IPDC must provide a site with a covered storage area for recyclable waste. The size of the area provided should be suitable for the bulk storage of up to 7 days of waste generation.

Waste collection from generators within the IAIP and RTC will need to occur on a daily basis in order to prevent garbage containers overflowing and waste littering the streets. To maintain a hygienic environment regular waste clearance is required.

8 PERFORMANCE MONITORING

INSPECTIONS

Site inspections must be performed by the Health, Safety and Environment (HSE) Officer for the Amhara IPDC. The IAIP site and RTC site should be inspected on a regular basis with a formally-documented inspection each month. Inspections will ensure that all commitments in this WMP are being enforced and that specific waste management elements are verified.

DATA COLLECTION

Implementation of the waste hierarchy principles requires that destinations and quantities of residual matter are monitored. A register of waste material should be maintained to ensure the measurement of eliminated waste and of residual matter sent for reuse, recycling and reclamation.

WASTE AUDIT

After a year of operation, a waste audit should be performed, on all waste data collected, to identify waste streams and fate and develop ways to reduce waste production.

9 PERFORMANCE INDICATORS

Measurement is an important tool in improving performance, and performance indicators will help the Amhara IPDC define and measure progress towards their goals. The results reflect current conditions and allow orientation and coordination of further actions towards sustainability.

ENVIRONMENTAL AUDIT RESULTS

Environmental auditing is a key process in the implementation of the Environmental and Social Management Plan (ESMP), of which the WMP forms a part. The findings of each audit should be registered in a database, where corrective and/or preventive actions are prescribed, responsibilities assigned to people, deadlines established and necessary resources mobilised.

In compliance with the procedure, audit reports should categorise findings as being either “major”, “minor” or “observation”. The number of findings shall be decreasing every year until the ultimate goal of zero major findings is achieved. This indicator is not specific to the WMP, but to all facets of the ESMP.

PERCENTAGE WASTE GENERATED

During the operational phase, the quantities and types of waste produced should be tracked for each department, and activities examined to identify waste reduction opportunities. Specific reduction target ratios should be determined and the rate of waste production is required to reduce annually relative to production volumes. Waste includes packaging and any residual product sent for disposal, both hazardous and non-hazardous.

10 RESPONSIBILITIES

The roles and responsibilities inherent to the WMP are presented in **Table 2** below.

Table 2: Roles and Responsibilities

Entity	Responsibilities
Amhara IPDC	<ul style="list-style-type: none"> - Enforce the Waste Management Plan. - Contractually obligate the Enterprises to meet the requirements of the Waste Management Plan. - Manage the Solid Waste Management Area or appoint an appropriate contractor. - Manage the Solid Waste Treatment plant or appoint an appropriate contractor. - Manage the Recycling and Recovery area or appoint an appropriate contractor.
Enterprises	<ul style="list-style-type: none"> - Provide a minimum of two garbage receptacles to each waste generator to allow for wet and dry waste segregation. An additional bin for hazardous waste is highly recommended. - Develop an Enterprise specific Waste Management Plan for the activities of said Enterprise. - Enterprise specific Waste Management Plan must be aligned with the full site WMP and must be approved by the IPDC HSE prior to commencement of operations. - Educate all members of staff on the waste hierarchy - Educate all members of staff on the Enterprise WMP and the Waste Management Plan for the IAIP/RTC. - Education is to be provided to each staff member prior to commencement of work, and regular refresher sessions are to be undertaken in the form of toolbox talks or training sessions throughout the operation of the facility.
Contractors	<ul style="list-style-type: none"> - Provide a minimum of two garbage receptacles to allow for wet and dry waste segregation. An additional bin for hazardous waste is highly recommended. - Develop a site specific Waste Management Plan for the activities the Contractor is undertaking. - Site specific Waste Management Plan must be aligned with the full site WMP and must be approved by the IPDC HSE prior to work commencing. - Educate all members of staff on the waste hierarchy.

Entity	Responsibilities
	<ul style="list-style-type: none"> - Educate all members of staff on site specific WMP and the Waste Management Plan for the IAIP/RTC. - Education is to be provided to each staff member prior to commencement of work, and regular refresher sessions are to be undertaken in the form of toolbox talks or training sessions throughout the contract period.

11 RECORD KEEPING

Data on waste production and disposal should be gathered continually via logbooks and registers. Records should be maintained on site and made available to the IPDC, authorities and any other party contracted to audit or assess the waste management practices on site. The data should include the final destination of each waste stream and where disposal has occurred proof of safe disposal will be required, such as a date stamped waste disposal ticket issued by a sanitary landfill. A cost should be paid for safe disposal of wastes. Evidence of waste disposal should also be maintained.

12 REVIEW PROCESS

The WMP is to be reviewed and updated on an annual basis.

Date of next review: December 2018