بسم الله الرحمن الرحيم

DESIGN GUIDELINES FOR WASTE MANAGEMENT FACILITIES

URA 3003:2023

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1. Purpose

This document provides a consolidation and general overview of standards applicable to all waste management facilities. The standards address the design of waste management facilities, to substantially reduce and mitigate adverse environmental impacts associated with management of waste materials. These impacts may include dust, odor or impaired air quality, noise, unsightly conditions, litter, nuisance, vector, rodents, leachate and surface water run-off and hazardous materials spills, exposure or fire. Innovative planning and design are encouraged to maximize safe, efficient, and productive use of the property that is dedicated to waste management over the life of a facility; to control the cost of closure/decommissioning and post-closure care; and to allow for future productive use of the facilities.

2. Design scope

The design requirements of these standards apply to all solid waste management facilities unless otherwise stated in these guidelines. These design requirements stipulated in this guideline are the minimum requirements necessary for design of all Waste Management facilities.
Based on the baseline information obtained, the designer should classify the waste management facilities as follow:

a) Classification of waste management facilities by scale
   i. Regional waste management facilities
      Waste management facilities that handle, store, process, and discard waste on a regional scale with various waste treatment technologies available for processing waste and final disposal.
   ii. Island waste management facilities
      Facilities established at Individual islands, cities, resorts, and commercial islands to collect and store and where possible process and dispose waste. The waste that cannot be processed in these facilities must be transported to further processing or disposal to a permitted regional waste management facility dedicated for the region.
   iii. Stand Alone facilities.
      Specialized Facilities that manage waste substantially independent of the type of facilities stated in part (i) and (ii) of this section.

b) Classification of waste management facilities by type
   i. Waste Transfer Facility
   ii. Waste Storage Facility
   iii. Waste Treatment Facility
   iv. Disposal Facility

Waste management facilities might be of a single type or a mix of different types. All necessary calculation and justification on the selected type of WMF should be mentioned in the design report.

3. Legislation and Approvals

Detail designs of waste management facilities are required to be approved by the Utility Regulatory Authority (URA) in accordance with Utility Regulatory Authority Act (26/2020) and Waste Management Act (24/2022)

All waste management facilities used for handling municipal solid waste is subject to registration in accordance with Waste Management Regulation (No.: 2013/R-58) and operating permit taken prior to operation of the facility.

4. General Design Parameters

The size of the Waste Management Facility (WMF) shall be based on projected population and the amount of waste generated estimated for a minimum design period of 15-years. The population shall be estimated with reference to relevant national census data and island population data and waste generation shall be estimated using waste audits.

Design criteria of WMF shall depend on the type; collection facility, transfer station, treatment facilities, disposal site and where applicable, must be in accordance with the criteria below:

4.1. Administrative / Office building.

An administration building shall be located at the site of the WMF. An office space with a storage facility with sufficient vehicle parking space, space for a standby generator set and space for service vehicles should be included in the design. In addition, sufficient space/room should be available for the purpose of maintenance of electrical equipment/vehicles. Adequate toilets and wash facility shall be provided to cater for both administration staff and plant operators. Fire safety equipment should be installed in the admin building and should comply with MNDF Fire and Rescue standards.

4.2. Fencing, Gate and Gatehouse

The boundary of the WMF must be clearly marked and closed off. It must be adequate to prevent unauthorized entry, airborne dispersal of litter and ash (where applicable).

A lockable access gate must be provided at the entry. Double swing gates may be provided at large facilities to allow two-way traffic. For smaller facilities the gate must be at least wide enough to allow one-way traffic for the vehicles3, or machinery that will be used during the operation of the WMF. An alternative emergency exit must be provided and clearly marked.

For type of facilities stated in 2 (a) (i) and b (i), provide provisions for gatehouse, where customer information and inspection of incoming waste and quantities can be recorded. For other facilities depending on the size, it is recommended for site design to have provisions for future development of gatehouse.

4.3. Roads, Traffic Routing, and Parking

Site shall be designed with one-way traffic with space for backing of vehicles where necessary without blocking public roads. Intersections with public roads must be designed with safety considerations for entry and exit.

Roads within the facility should be designed with all-weather surfaces, enough width for intended vehicles, and turning radius designed for largest vehicles. Roads must be paved. Additional measures must be added to prevent excessive erosion and generation of dust.

Space must also be provided for employee and visitor parking, transfer vehicles, and containers (When designing a WMF it is important for developers to determine the type of collection that will be used when calculating container requirements), where applicable.

The following design elements should be included to allow a collection vehicle to enter the site, unload the waste and exit without having to reverse onto a public road, as this pose risks of pedestrian and vehicle accidents.

ELEMENT	DESIGN GUIDELINES
Entry and Exit	- Allow collection vehicles to enter the site, collect/dispose waste, leave the site in a forward motion or via the use of a turnabout area allowing for a three-point turn of no less than one truck length - If backing up is the only option, it must not compromise building structure, traffic operations and safety
Driveway Access	- Minimum width of 6 meters at the points of entrance and exit for the site
Slope	- Ensure slope of access does not exceed 6%
Vehicle Access Route	- Minimum width of 4.5 meters throughout vehicle access route
Vehicle Clearance	- Maintain a minimum vehicle clearance of 4.5 meters throughout the entire access route
Turning Radius	- Provide the collection vehicle a minimum turning radius of 12.5 meters throughout the entire access route - Building structure, such as an overhang, cannot extend pass the turning radius to prevent damage to the building

4.4. Collection, Sorting, Storage and/or Containment Areas

When designing a WMF it is important for developers to determine the type of collection that will be used in the service area when calculating container requirements

A storage facility is designed to allow containers to be easily accessed and moved. Collection, sorting, storage and/or containment areas must be a roofed area with adequate ventilation. The roof height must be high enough to accommodate the vehicles and machinery that will be using the site, with enough clearance for beams, overhead lights, and doorways.

Drop off points for recyclables and reusable items may be places adjacent to drop off point for mixed wastes, with sufficient space for manual sorting if required. All recyclables must be stored in a covered area.

The floors of all collection, sorting and storage or containment areas shall be impermeable. Containment designed to prevent leachate from entering the environment and to contain and to collect runoff.

The areas where waste is stored will need to have a proper grade/slope so that any runoff will flow into drains.

Ideally, there should be a separate room designated; however, if a separate room is not feasible, a shed or enclosure is a viable option. In all cases, the area must be large enough to store all recycling and waste between designated collection days and allow the movement of the

containers. Designated areas must also meet fire safety requirements. The storage facility should include the following considerations as a minimum standard.

ELEMENT	DESIGN GUIDELINES
Floor	Must have a hard surface (concrete is required if installing a compactor) that is able to withstand a 28-tonne collection truck
Drainage	• Must drain to sanitary sewer. • Oil separator required at food services and restaurants
Door	Must contain a double door to ensure there is enough space to move the containers
Size	• Configure to allow each waste container to be individually accessed, removed and replaced without having to take out other containers. • No horizontal dimension (width or depth) is less than 2 meters to allow for access to waste containers
Ventilation	Have adequate ventilation for reduced smell and odor, and be in compliance with the BC Building Code requirements for ventilation
Security	• Be protected from unlawful entry. • Be equipped with locked doors or the containers should also be locked if they are accessible from outside the building to avoid illegal dumping
Lighting	Be well lit, both as a security measure and for ease of access. Adequate lighting also discourages improper use of the containers and surrounding area
Signage	Must have clear signage in garbage and recycling facilities and on containers to ensure that materials go in the appropriate container to help prevent contamination

4.5. Weighbridges and scales

Facilities stated in section 2 (a) (i) and b (i) is required to have weighbridge installed. It is recommended to have weighbridges in all type of waste management facilities.

Weighbridges and scales may be placed at the gatehouse or near collection areas with sufficient space for vehicles.

Where installation of weighbridge is not required at present or affordable, site design should have provisions for future installation of weighbridge.

4.6. Mechanical equipment and Workshop or Maintenance Area

All mechanical equipment shall be installed according to manufacturer's requirements with sufficient working space and clearances provided for optimal running. Where equipment is placed in a covered structure, adequate ventilation must be provided.

Workshop and maintenance area for mechanical equipment and vehicles may be provided where necessary. The area must be paved to prevent spill of oil and greases on to the ground, with suitable traps installed at the drain besides the pave must be impermeable to oil.

4.7. Drainage

An efficient storm water drainage system shall be included in the facility, designed in a manner that water discharged from the facility shall be free of components which pose a danger to the environment. Drainage must be provided for overall site, including pathways and runoff may be collected to a sump of adequate size, with inner lining to prevent corrosion, through gravity collection via a piped network. Oil and grease traps must be provided before wastewater reaches sump.

4.8. Leachate collection and disposal

All waste management facilities shall incorporate a collection system designed to collect leachate that maybe associated with incoming waste materials. leachate collection tanks designed shall be.

- double-walled with an interstitial space.
- sized appropriately for the facility and volume of waste managed.
- of material compatible with the expected composition of the leachate; and
- able to be tested or inspected for leak detection.

The design plan shall be provided for leachate management. This design plan shall include the following:

1. An estimate of the quality and quantity of leachate to be produced annually by the facility. The estimate shall include the 30-day leachate volume and average flow rate of each month of the year. A separate estimate shall be submitted for anticipated leachate generation at the end of five-year increments of operation for 20 years, or until closure, whichever date is earlier. For existing facilities, current leachate generation shall be included with this separate estimate.
2. The leachate collection system shall be designed and constructed to maintain less than a 30 cm depth of leachate over the liner, excluding manifold trenches and sumps.
3. Plans, designs, and cross sections for the proposed collection and handling system.
4. Plans, designs, and cross sections for onsite leachate storage or treatment systems, including system appurtenances for storage, pretreatment, or treatment of leachate from the facility.

Tanks and surface impoundments used for storage of leachate shall have a flow equalization and surge capacity at least equal to the maximum expected production of leachate for any seven-day period for the life of the facility estimated under 1 of this section. Leachate storage capacity may not be considered to include leachate that may have collected in or on the liner system. Storage tanks and impoundments shall be aerated, as necessary, to prevent and control odors.

Surface impoundments used for storage of leachate shall be equipped with a liner system.

The collected leachate shall be:

1. Discharged directly or after pretreatment into a line leading to the publicly owned treatment works or other permitted wastewater treatment facility.
2. Transported by a vehicle to an offsite permitted wastewater treatment facility.
3. Other methods of treatment or disposal as approved by the URA.

The collected leachate shall not be discharged to an underground drain field.

Leachate seeps. If a leachate seep(s) occurs, the owner or operator shall repair the seep(s) and do the following:

1. Take all immediate steps necessary to protect public health and safety including those required by the contingency plan.
2. Take immediate action to minimize, control, or eliminate the seep, and to contain and properly manage the leachate at the source of the seep.
3. Any leachate released outside the lined area permitted for waste disposal shall be properly collected and disposed.

Leachate must similarly be collected from all collection, sorting, storage and/or containment areas and piped to a sump of adequate size, with inner lining to prevent corrosion, through gravity collection via a drainage or piped network. Wastewater collected in the sump shall be adequately treated before disposal as per existing guidelines.

4.9. Utilities and Other Services

Facilities must be provided with adequate power, water, and sewerage facilities.

4.9.1 Power services

All power outlets in collection, sorting, storage and/or containment areas and open areas must be covered with weather and spill proof housing. Similar measures must be provided for any outlets or electrical components that are is areas where spills or splashing can occur.

4.9.2 Water supply and sanitation services

Internal plumbing services should be designed for the WMF and the pressure of the plumbing network should be maintained at 2 bars. Hand washing stations must be provided within the facility. Toilet and/or washroom must be provided for the staff at the site and toilet and/or washroom should be connected to the sewer network via an inspection chamber. In case there is no sewer network in the project island, the toilet and/or washrooms can be connected to a septic tank approved by the URA. In this case, the proposed septic tank design should be included in the detail design report.

4.10. Signs and Information

Sign boards with name of facility, service hours, services, fees and types of waste collected must be displayed at the entrance of the site. Signs on the site should include directions for customers, traffic route, speed limit, site rules and procedures, waste types and listing.

Areas where access is limited or controlled must be marked clearly and safety signboards for fire, hazardous waste, traffic and road must be provided at respective areas.

Signs must be provided in languages customers, operators and staff can understand. Signs must include Visual Ques to convey information.

4.11. Fire Safety and Prevention

Emergency procedures to be used in case of fire, including sounding alarm, provisions for access for firefighting, instructing occupants on procedures to be followed when the fire alarm sounds evacuation, confining controlling and extinguishing the fire.

Instruction and schematic diagrams describing the type, location, and operation of WMF fire emergency system should be designed as per MNDF Fire Safety Standards.

5. Design Criteria based on Type of Facility and Treatment Methods

Following criteria will be based on treatment or processing method used for waste. This will not be a guideline for the process itself but the design criteria and requirements for areas where the method of treatment will be used.

5.1. Transfer Stations

An all-weather road suitable for loaded collection vehicles shall be provided from the entrance gate to the unloading, receiving, or tipping area. Design report should include the design of the on-site roadways, odor controlling mechanism, transfer route of transfer vehicles to the disposal site and the efficient on-site traffic control system.

The designed site roads shall be either asphaltic concrete or reinforced concrete type. The minimum width of the one-way road is 3.5 meters and 6.0 meters for the two-way traffic road.

The floors in the unloading, receiving, or tipping areas shall be constructed of easily cleanable materials, provided with a water supply for transfer area cleaning purposes, and equipped with drains or pumps, or equivalent means to facilitate the removal of wastewater to proper storage or disposal.

Design of the proposed structures and areas designated for unloading, storage, compaction and loading which are in an enclosed building or covered areas with all the instruments or devices must be installed for ventilation and controlling dust, litter and odor.

Design of an efficient storm water management system. Storm water discharged from the facility shall be free of components which pose a danger to the environment.

Truck wheel curbs or other safety facilities shall be provided to prevent backing or falling into a pit if the facility is used for tipping.

Onsite queuing capacity shall be provided for the expected traffic so that the waiting collection vehicles do not back up onto the public road.

Portions of the transfer station used solely for storage of household hazardous waste shall have a containment system designed.

If the transfer station is used to store waste materials, storage units shall be designed to reduce the potential for fires and migration of vectors, and to prevent escape of wastes, wash waters, odors, dust, and litter from the facility.

Specifications of all machinery, equipment and vehicles to be used in the facility shall be submitted along with the detailed design report.

- Type, numbers, capacities shall be detailed.
- Large transfer vehicles shall be fully covered at loading compartment and leachate collection box shall also be prepared to prevent littering and leachate spill during transportation.

Design of other necessary components as appropriate to the allocated area, i.e., office building, maintenance shop, vehicle parking area, truck wash bay, wheel cleaning equipment, staff rooms, gate, guard house, fence, green belt, buffer zone, landscaping, and utilities

5.2. Waste Incineration Facilities

Design of the site plan with appropriate scales showing details of the proposed areas going to be used for the facility and lay out plan of equipment installation.

Design of the proposed building structures and areas designated for unloading, storing, loading, burning, bottom ash and flue ash collection and ash storing until final disposal. The proposed waste storing area in the facility shall accommodate at least three times of the daily average tonnage of waste.

Specifications of all machineries, equipment, and vehicles to be used in the facility. Type, numbers, capacities, or efficiencies shall be detailed in the design report.

Design of the on-site roadways, odor controlling mechanism, transfer route of transfer vehicles to the disposal site and the efficient on-site traffic control system. The designed site roads shall be either asphaltic concrete or reinforced concrete type. The minimum width of the one-way road is 3.5 meters and 6.0 meters for the two-way traffic road.

Fire alarm and protection systems capable of detecting, controlling, and extinguishing any and all fires shall be provided.

Design of wastewater treatment system for treating the effluent to achieve the national standards

Design of air pollution control system and stacks.

Design of other necessary components as appropriate to the allocated area, i.e., office building, maintenance shop, vehicle parking area, truck wash bay, wheel cleaning equipment's, staff rooms, gate, guard house, fence, green belt, buffer zone, landscaping and utilities.

A detailed description shall be provided in the design report showing

1. The processing rate of the facility
2. The designation of normal loading, unloading, and storage areas and their capacities;
3. The designation of emergency loading, unloading, storage or other disposal capabilities to be used when the facility system downtime exceeds 24 hours;
4. The designation of alternate disposal areas or plans for transfer of solid wastes in the event facility downtime exceeds 72 hours;
5. The expected daily quantity of waste residue generation;
6. The proposed ultimate disposal location for all facility-generated waste residues including, but not limited to, ash residues and bypass material, byproducts resulting from air pollution control devices, and the proposed alternate disposal locations for any unauthorized waste types, which may have been unknowingly accepted. The schedule for securing contracts for the disposal of these waste types at the designated locations shall be provided
7. A descriptive statement of any materials use, reuse, or reclamation activities to be operated in conjunction with the facility, either on the incoming solid waste or the ongoing residue;
8. Plan views showing building dimensions, building setbacks, side and rear distances between the proposed structure and other existing or proposed structures, roadways, parking areas, and site boundaries; and
9. Interior floor plans showing the layout, profile view, and dimensions of the processing lines, interior unloading, sorting, storage, and loading areas as well as other functional areas.

5.3. Composting

A handling area and equipment shall be provided to segregate the compostable waste from Non compostable components and to store such components in appropriate containers prior to proper management and disposal.

Areas used for mixing, composting, curing, screening, and storing shall be graded to prevent run-on, collect runoff, and provided with a drainage system to route the collected runoff to a treatment, disposal or holding facility, discharged under a VPDES permit, or recirculated within the composting process.

Auxiliary power, standby equipment, or contingency arrangements shall be required to ensure continuity of composting operations.

For uncovered sites, calculations for sizing of surface water control features will be based on a rainfall intensity of one hour duration and a 10-year return period.

Design of the site plan with appropriate scales showing details of the proposed areas used for particular activities in the facility, with contour lines.

Design of the proposed structures and areas designated for unloading, storage, sorting out, composting, processing, final product storage with all the instruments or devices which must be installed for ventilation, controlling dust, litter and odor.

The base of the composting area shall be impermeable.

Provision shall be made for weighing or measuring all incoming and transferred solid waste.

Buffer zone: an adequate area for a buffer zone shall be designed for inside surrounding area next to the property boundary. This area may be dedicated for road, drainage ditch, selective tree planting for visual screening or reducing scenery and odor problems. However, the relevant authorities must be consulted regarding the exact distance to be maintained depending on the capacity of the composting plant and the proposed site.

Specifications of all machineries, equipment, and vehicles to be used in the facility (Type, numbers, capacities shall be detailed).

Design of an efficient storm water management system. Storm water discharged from the facility shall be free of components which pose a danger to the environment.

Design of wastewater treatment system for treating the effluent to achieve national wastewater discharge standards.

Design of other necessary components as appropriate to the allocated area, i.e., office building, maintenance shop, vehicle parking area, truck wash bay, wheel cleaning equipment, staff rooms, gate, guard house, fence, green belt, buffer zone, landscaping and utilities.

If windrows (long piles of compost) are planned, sufficient area should be provided between windrows to allow for operators to turn and mix the compost piles during maturing and curing.

The facility should be designed as per the composting method chosen and indicate whether it will be fully mechanical turning or if they will use anaerobic methods? Or forced aeration.

5.4. Anaerobic Digestion / Biogas Production Facility

Design of the proposed structures of the digesters, gas collection facilities, gas utilization facilities and areas designated for unloading, storage, sorting out, processing, final product storage with all the instruments or devices which must be installed for ventilation, controlling dust, litter and odor.

The digesters and gas collection facilities must be fully airtight and gases should not be released without utilization.

1. Provision may be made for weighing or measuring all incoming and transferred solid waste.
2. Buffer zone: an adequate area for a buffer zone shall be designed for inside surrounding area next to the property boundary. This area may be dedicated for road, drainage ditch, and selective tree planting for visual screening or reducing scenery and odor problems. However, the URA must be consulted regarding the exact distance to be maintained depending on the capacity of the plant and the proposed site

Specifications of all machineries, equipment and vehicles to be used in the facility (Type, numbers, capacities shall be detailed)

The designed site roads shall be either asphaltic concrete or reinforced concrete type. The minimum width of the one-way road is 3.5 meters and 6.0 meters for the two-way traffic road.

Design of an efficient storm water management system. Storm water discharged from the facility shall be free of components which pose a danger to the environment.

Design of effluent treatment system for treating the effluent to achieve the national discharge standards.

Design of other necessary components as appropriate to the allocated area, i.e., office building, maintenance shop, vehicle parking area, truck wash bay, wheel cleaning equipment, staff rooms, gate, guard house, fence, green belt, buffer zone, landscaping and utilities.

Design of fire protection system / fire control system in the facility

5.5. Compaction

There should be adequate space for the waste bales to be stored prior to disposal or being shipped for recycling or processed. Moreover, proper maintenance and the disposal of compacted wastes must be managed accordingly.

5.6. Shredding

Provide the space required for the machine and manage the shredded waste.

5.7. Burning

Oen burning should be only conducted only if necessary.

Open air burning should be done in burning grill which is 1feet from the ground and fire safety requirements are the compulsory requirements. The burning grill should be placed in a concrete surface where the ash from the burning can be collected. The location for the burning should be decided on the wind direction and speed in both the monsoon seasons.

5.8. Storage

Specific area to store the residential waste, commercial, industrial, institutional, municipal waste and the construction and demolition until the final disposal. Storage areas should have label that clearly mention what type of waste should be kept in these areas.

5.9. Disposal facility

The following design requirements shall be applied to the disposal facilities

Facilities shall be designed to protect surface water, groundwater and the air, by detecting, through monitoring where appropriate, the emission or discharge of contaminants.

New landfills or new operational units at an existing facility, should have liner and leachate collection systems and appropriate provisions for leachate treatment.

Expansion of an existing plant with verified groundwater quality data may be allowed. It must be proven with design measures that the planned expansion activities will not aggravate the existing pollution and that remediation, containment, and/or monitoring of the existing contamination will take place concurrently with the expansion operations. The design for expansion at a facility with existing contamination must provide:

1. sufficient environmental monitoring to assess the impacts of the expansion prior to a point or points of compliance and provide for the capability of remediation within property boundaries if necessary.

2. any additional monitoring systems necessary to monitor the proposed expansion area independently of pre-existing operational units (monitoring systems beneath the liner of the expansion area, expanded monitoring well networks, tracer systems etc.).

3. Designer should demonstrate through modelling, or other means, that existing contamination will not be worsened by the expansion

General requirements for Landfill facility

Landfills shall not be established in inhabited islands.

Prior to the establishment of the facility, hydrogeological investigations shall be conducted for the proposed landfill site, including groundwater levels, quality of groundwater and surface water, topography, public and private water wells within 30-meter radius of the landfill site.

Prior to the establishment of the facility, geotechnical Investigation shall be conducted exploring the subsurface conditions, groundwater table conditions, soil permeability, landslide areas, sink holes, fault areas, foundation analysis to support the loads and stress from the landfill and sub-grade settlement after land filling.

Landfills shall have a Liner System where liners shall be constructed of materials that have appropriate properties to prevent failure due to physical contact with the waste or leachate to which they are exposed. Liners must be installed upon the geologic condition that can support the applied stress and to cover all surrounding earth which could come into contact with the waste or leachate. Any environmentally accepted technology which totally prevents pollution by way of the leachate coming into contact with the groundwater shall be applied.

Landfills shall have a Leachate collection and removal system which shall be constructed of materials that are chemically resistant to leachate and have sufficient mechanical properties to prevent collapse under pressure exerted by overlying wastes, cover materials, and by any equipment used at the landfill.

The facility shall have a Leachate treatment system to control and treat the leachate from the leachate collection and removal system. The effluent shall be treated to achieve the national waste water quality standards published.

Landfills shall have gas monitoring and control system installed that minimize both gas migration and emissions. The system shall be able to limit the concentration of methane gas as per national or international standards accepted by relevant environmental authorities.

Landfill shall have a storm water management system that shall include detention/retention ponds and drainage ways and shall be able to, at a minimum, prevents storm water from running on to those portions of the landfill which have not been closed. And this system shall collect and control, at a minimum, the volume of runoff from a storm event and prevent the mixing of storm water with leachate

The fire control system in the landfill facility shall control surface fires and sub surface fires

The land fill final cover system shall be placed above the waste material to control the amount of surface water infiltration, limit erosion and sedimentation and control the release of methane gas from the facility and protect the underlying waste from exposure. The cover system shall consist of a grading pad, low hydraulic conductivity layer, drainage layer and vegetative layer.

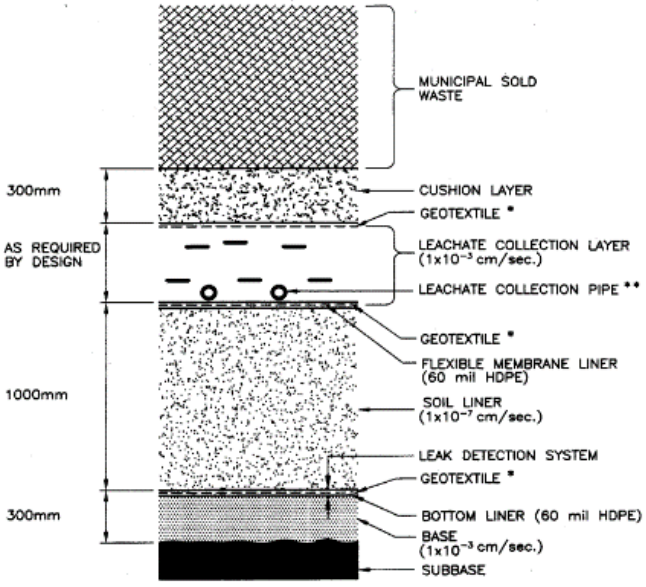

Figure 1: Cross section of a typical landfill liner system

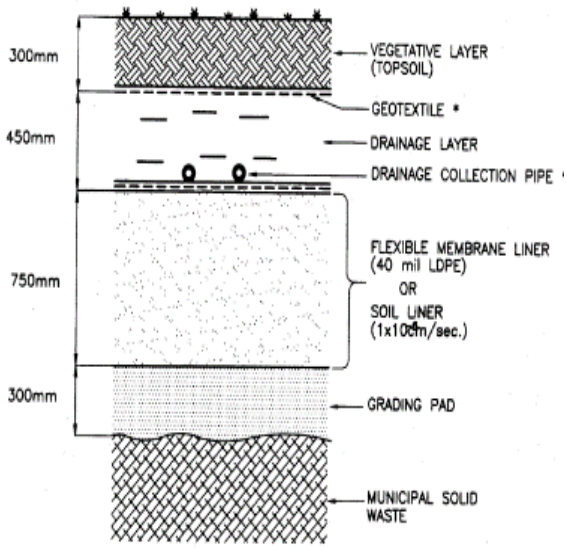

Figure 2: Cross section of a typical final cover system

5.10. Hazardous and Special Waste

Hazardous waste must be stored in a covered and sealed room or area with limited access. Hazardous waste must be stored in specialized containers or the original container that the chemical was supplied in., And container must be labelled with respect to the type of waste. The flooring must be impervious, and the surface shall be treated to prevent corrosion. The storage must be well ventilated. Furthermore, proper storage and handling is an important practice to promote a safe environment. In addition:

1. Prominently display weather-resistant labels that indicate the name and type of the hazardous waste.
2. Use storage containers that are compatible with the type of waste stored, and are made of durable, weather- and corrosion resistant materials.
3. Ensure wastes are stored in an area that is inaccessible to unauthorized persons, clearly identified as a hazardous waste storage area, and designed to prevent secondary containment.
4. Implement a secondary containment system for all containers used to store hazardous wastes, and for all equipment used in transporting hazardous wastes that are in a liquid or gas form.

Sites that accept waste oil must store the waste oil in above ground tanks that are secured to prevent the tanks from tipping over. Tanks must be protected from vehicular traffic by bollards or similar devices. Tanks must be constructed of steel or other nonporous material. They may not be located where any leaks could drain into sewers, floor drains, or storm water catch basins.

If a tank is located outdoors, the tank must be watertight, either double-walled or have a secondary impervious containment system that has the capacity to hold a minimum of 110% of the contents of the tank. The tank and the secondary containment system must either be covered with a roof or provisions made for removing liquids which accumulate in the containment system. If a tank is located inside a building, it must have rigid piping, a funnel that is rigidly attached, and either be double-walled or have an alternate means of secondary containment that has the capacity to hold a minimum of 50% of the contents of the tank.

All storage sites that accept waste paint must store the paints in a covered, well-ventilated structure having an impervious floor.

5.11. Methods not specified

The methods not specified under this guideline need to be preapproved by submitting to the URA with detailed specifications.

6. Waste Processing Technology

The best available technology should be opted when designing WMF. The available waste processing technologies can be broadly divided into two categories.

(1) Biological treatment and
(2) Thermal treatment.

The Biological treatment process is accomplished by allowing to micro-organisms to degrade waste components by creating conducive environment for growth of microbial organisms. In the

biological process, the biodegradable organic portion of waste is broken down into gaseous products (CO2, Methane gas, etc.) and water molecules leaving behind carbon rich byproduct called compost. The biological activities depend upon several criteria- C/N ration, pH value, moisture content, supply of oxygen, etc. Biological processes for waste treatment can be further divided into two categories.

(a) Aerobic treatment (in presence of Oxygen) and
(b) Anaerobic treatment (absence of Oxygen).

The thermal process of treatment is applied to destroy the harmful potential of wastes together with energy recovery. In this process, the waste components are incinerated in controlled oxygen supply so that maximum heat energy can be recovered without causing the air pollution. During incineration, the waste undergoes chemical changes to release gaseous byproduct, water vapor along with heat energy. The heat energy can be utilized for generating electricity through boiler. The efficiency of heat recovery depends upon the calorific value of incinerated waste.

6.1. Design Criteria for selection of Waste Processing Technology

For planning and designing of a waste management system, a preliminary survey is required to be obtained from the city/island and accordingly selection of waste processing technologies can be done for the city/town. In case of waste quantity is found to be less than the requirement, a regional system may be prepared for clusters of islands to achieve the desired quantity of waste. In case of excessive generation of waste, the waste can be reduced by adopting decentralized treatment process (vermin-composting/Biogas). The primary criteria for selection of waste processing technologies are as under;

1. Quantity of waste generation
2. Characteristics of waste (Physical and chemical property)
3. Based on land availability (Annexure-I)
4. Prevailing environmental conditions
5. Climatic condition and terrain
6. Social acceptance
7. Capital investment
8. Siting criteria
9. Environmental norms

The quantity of waste generation plays vital role in selection of waste processing technologies. Vermi-composting and Biogas plants are capable of handling effectively up to 30 Ton/per day and suitable for small islands. Aerobic composting plants are found operational up to 500 Tons/day. The waste-to Energy plants are found cost-effective for processing waste 500 Tons/day and above.

The design calculation should use waste characteristics such as C/N ratio, moisture content, calorific value, etc. which indicate the treatment technology to be adopted. The desirable C/N ratio for composting is 30:1 with moisture content 50-60%.; otherwise, these parameters are maintained by addition of some selected wastes. The desirable calorific value of waste considered for incineration should not be less than 1500 Kcal/kg. The desired calorific value of waste can be achieved practicing effective segregation of wastes.

While choosing a treatment technology, consideration should also be given to national waste management policy and regional waste management plans.

6.2. Key Criteria for Solid waste Incineration

Incineration projects are appropriate only if the following overall criteria are fulfilled:

1. Incineration is especially relevant for the dry bin content in a 2-bin system. For unsegregated waste, pre-treatment is necessary.
2. The lower calorific value (LCV) of waste must be at least 1450 kcal/kg (6MJ/kg) throughout all seasons. The annual average LCV must not be less than 1700 kcal/kg (7 MJ/ kg).
3. The furnace must be designed in line with best available technologies to ensure stable and continuous operation and complete burn out of the waste and flue gases.
4. The supply of combustible waste should be stable and amount to at least daily processing capacity of the incinerator.
5. Produced electricity and/ or stream can be sold at a sustainable basis (e.g., feeding into the general grid at adequate tariffs). It is possible to absorb the increased treatment cost through management charges, tipping fees
6. Skilled staff can be recruited and maintained. Since the capital investment is very high, the planning framework of the community should be stable enough to allow a planning horizon of 25 years or more.
7. Pre-feasibility study for the technology led to positive conclusions for the respective community.
8. Strict monitoring systems are proposed and monitored

6.3. Mitigation Measures

In the WMF design mitigation measures to be taken at sites should be taken into consideration which is dependent on type of management facility and operations at site.

WMF design shall include mitigation measure for noise, dust, litter, environmental impacts, health hazards, vectors, pests, run off and leachate.

6.3.1. Waste Collection Facility

- Containment of liquids (including run-off) on the site though internal collection drains.
- Prevention of windblown litter through the installation of perimeter fencing.
- Designated collection skip bins for all waste items.
- Covered areas for storage of waste before transfer for selected items.
- Separate collection for resource recovery (metal, glass, rubble, etc.)
- Vector and pest control measures (flies, mosquitoes).
- Adequate signage information, directions and for dumping areas
- Impermeable flooring with provisions for drainage in collection, sorting and storage areas, including composting areas where applicable.

6.3.2. Waste Transfer Station

- Containment of liquids on the site though internal collection drains.
- Prevention of windblown litter through the installation of perimeter fencing.
- Designated storage for all waste items.
- Covered transfer station for storage of selected waste items.

- Separate storage for resource recovery.
- Vector control measures.
- Adequate signage information, directions and for dumping areas

6.3.3. Final Disposal Site

- Impermeable surface (clay, geotextile) for landfill sites.
- Collection and treatment of leachates.
- Prevention of windblown litter through the installation of perimeter fencing.
- Semi-aerated design.
- Collection and safe removal of gases.
- Vector control measures.
- Adequate signage information, directions and for dumping areas.

7. Environmentally friendly design consideration.

The designer should include environmentally friendly technology and concepts in the WMF design. Following environmentally friendly design considerations can be proposed.

1. Energy saving technologies (solar, energy recovery devises, etc)
2. Stormwater retention and infiltration techniques in WMF premises
3. Environmentally friendly building materials
4. Greywater and wastewater reuse concepts
5. E-Vehicles
6. Any other relevant technologies

8. Operational and maintenance cost

The design report should include the expected operational and maintenance cost for the WMF. This should include monthly cost of utility services, operational and maintenance cost, staff salaries and any other related cost to operations.

9. List of spare parts

A list of spare parts that would be require for the operations should be included in the design report.

10. The following information/documents are required to be included in the details design report

- Material standards
- Catalogs of Material and Equipment
- Land Approvals
- Environmental Clearance