

Solid Waste Management

Standard Operating Procedures for Swachh Campus

10 Steps to a Swachh Campus

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DRAFT

INTRODUCTION

Background

There are many educational, training and research institutions in India that have administrative and academic blocks, training and conference halls, canteens, hostels, dining halls, residential quarters and so on. It is predictable all of them generate waste in their day to day work. Waste is something one cannot do away with – completely. However, it is possible to reduce generation of waste, and manage wastes scientifically. This demands planning, preparation of logistics, community education, and proper treatment and disposal of different types of wastes. The National Institute of Rural Development and Panchayati Raj (NIRD&PR), Hyderabad took up an action research in its campus at Hyderabad on solid waste management (SWM). This Standard Operating Procedures (SOP) for SWM comes out of the experience gained in an action-research mode.

Scope of this SOP

1. This SOP covers solid waste management in any training and research institution starting from how to conduct a waste survey to preliminary preparations, to logistics, collection, transport and treatment.
2. This SOP covers the solid waste management in office buildings, training halls, dining halls, hostel and hostel kitchens, staff quarters, and lawn area within a campus. And it is deliberate it does not discuss much about the toilets, urinals, wash basins etc. because they are covered at length by Swachh Office SOP introduced by the Ministry of Urban Development (MoUD).
3. This SOP is for Sanitation Inspectors of institutions / or any team of staff involved in waste management in a campus. It assumes that either no system of waste collection exists or there is a substandard system of waste collection, and disposal in place.
4. It entails ten steps to a Swachh Campus

Vision Statement

Swachh Campus bymonth.....year

Objectives of this SOP

1. Put in place a system for scientific management of waste generated in the campus so that residual reject which ends up in the landfill shall not exceed 10% of the total waste generated, and the remaining are either converted as manure, or passed on for recycling / down-cycling.
2. The system put in place for waste collection, transport, treatment, and disposal should augur well as a scientific practice in waste management in any educational, training and research institution that should become and remain completely clean.

How to use this SOP?

This SOP aims at serving as a step-by-step guide for waste management in institutions / campuses. The main user of this SOP is Sanitation Inspector or Team In-charge. This sets out to identify the types of wastes, category of waste generators, how to collect, handle and dispose wastes; and who will be responsible for what? ‘Waste Survey’ is the first step and a common reference-point for anyone wanting to start a scientific practice in waste management – be it a person in-charge of a training hall or dining hall. Similarly, each one of the ten steps mentioned in this SOP has to be carried out for a complete waste management system to get installed.

10 Steps to a Swachh Campus

1. Waste Survey
2. Plan and Prepare
3. Facility, Equipment and Logistics
4. Waste Segregation (+ Secondary Segregation and Resource Recovery)
5. Refuse - Reuse – Recycle – Recover – Regenerate
6. Waste Treatment & Disposal
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STEP –1

WASTE SURVEY

Introduction

In setting up a solid waste management system the first place to start is: Waste Survey. To begin with, we need to identify sources of wastes; types of wastes; and quantum of waste generated.

- A. Sources of Wastes (Waste Generators)
- B. Types of Wastes (Wet / Dry / Hazardous / e-waste)
- C. Quantum of Waste Generated (How much waste is generated under each type?)

A. Sources of Waste / Waste Generators

The first thing is to prepare a complete list of waste generators in the campus.

- i. Office Buildings / Blocks
- ii. Library
- iii. Training / Conference Halls / Students Classrooms
- iv. Auditorium
- v. Canteen
- vi. Trainees Hostel
- vii. Students Hostel
- viii. VIP Rooms
- ix. Dining Halls
- x. Hostel Kitchen
- xi. Hostel Grocery Stores Room / Crockery Store Room
- xii. Health Centre
- xiii. Play Ground
- xiv. Staff Quarter Lanes
- xv. Households that Reside in the Campus
- xvi. Matriculation School (if any, within the campus)
- xvii. Bank (if any, within the campus)

Note: There could be many similar categories, it is good to merge and accommodate them into a few handy, workable categories. For instance, if there are more than one ‘trainee hostels’, unless there is specific reason, all the trainee hostels can be brought under ‘Trainee Hostels’. Similarly, there could be more than one training hall / conference halls. All of them can be brought under ‘Training / Conference Halls’ for the purpose of the survey. Once we have exhausted listing out,

we can move to types of waste generated by each category of Waste Generators. At this stage it is prudent to combine *both the type of waste generated plus the quantity of waste generated*. The format given below can be used individually for each category of waste generators we identified. There is one more format, which gives a consolidated picture of the total quantity of waste generated (Disaggregated – type-wise / source-wise – See [Annexure - 3](#))

B. Type & Quantum of Wastes Generated

(i) Wet Waste – Kitchen Waste

Sl.	Type of Waste (WET)	Quantity (daily) grams	Quantity (Weekly) In kgs	Quantity (Monthly) In kgs

Note: See Annexure – 1 for a sample list of ‘wet waste’.

(ii) Dry Waste

Sl.	Type of Waste (DRY)	Quantity (daily) grams	Quantity (Weekly) In kgs	Quantity (Monthly) In kgs

Note: See Annexure – 1 for a sample list of ‘dry waste’.

(iii) Hazardous Waste

Sl.	Type of Waste (HAZARDOUS)	Quantity (daily) grams	Quantity (Weekly) In kgs	Quantity (Monthly) In kgs

Note: See Annexure – 1 for a sample list of ‘hazardous waste’

(iv) e-waste

Sl.	Type of Waste (e-WASTE)	Quantity (daily) grams	Quantity (Weekly) In kgs	Quantity (Monthly) In kgs

Note: See Annexure – 2 for a sample list of ‘e-Waste’

The format given above can be used for each category of waste generators. This can later be consolidated into one format using [Annexure – 3](#).

C. Assessing the Quantity of Waste

Make a daily visit of all the places listed at least for one week. Recording the wastes generated for a week can give an estimation of the types and quantum of wastes generated by each category of waste generators.

Watch Out: When it comes to residents in the staff quarters one week’s assessment shall give a fairly good idea of various types of waste generated. However, the amount of waste generated in the hostel kitchen and dining halls tend to highly fluctuate depending on the number of programmes conducted. Therefore, it is good to consolidate it for a month’s period, especially when it comes to trainees’ hostels, kitchen and dining halls.

Assess the Existing Practice of Waste Disposal

a. Arrangement for Waste Segregation

Sl.	Waste Generators	Arrangement for Segregation Available	Arrangement for Segregation Not available
1.	Office Buildings (e.g. Wing A) (e.g. Wing B)		
2.	Computer Centre		
3.	Library		
4.	Training / Conference Halls		
5.	Students Classrooms		
6.	Auditorium		
7.	Canteen		
8.	Trainees Hostel / VIP Rooms		
9.	Students Hostel		
10.	Kitchen – Trainees’ + students’		
11.	Dining Halls – Trainees/students		
12.	Hostel Kitchen Grocery Store Rooms		
13.	Hostel Crockery Store Room		
14.	Health Centre		

15.	Play ground		
16.	Staff Quarter Lanes/surrounding		
17.	Residential Houses		
18.	Matriculation School		
19.	Crèche (Child Care Centre)		
20.	Sports Complex		
21.	Power Room		
22.	Community Hall		

b. Arrangement for Waste Collection

		Available	Not available	If available, Who collects	Frequency of collection
1.	Office Buildings (e.g. Wing A) (e.g. Wing B)				
2.	Computer Centre				
3.	Library				
4.	Training / Conference Halls				
5.	Students Classrooms				
6.	Auditorium				
7.	Canteen				
8.	Trainees Hostel / VIP Rooms				
9.	Students Hostel				
10.	Kitchen – Trainees’ + students’				
11.	Dining Halls – Trainees/students				
12.	Hostel Kitchen Grocery Store Rooms				
13.	Hostel Crockery Store Room				
14.	Health Centre				
15.	Play ground				
16.	Staff Quarter Lanes/surrounding				
17.	Residential Houses				
18.	Matriculation School				
19.	Crèche (Child Care Centre)				
20.	Sports Complex				
21.	Power Room				
22.	Community Hall				

c. The existing practice of waste disposal

		Genitors Appointed by the institute's Sanitation Contractors dispose away from sight	Disposed at common waste bins for Municipality to clear up	Dumped in road side, and street corners / vacant plots
1.	Office Buildings (e.g. Wing A) (e.g. Wing B)			
2.	Computer Centre			
3.	Library			
4.	Training / Conference Halls			
5.	Students Classrooms			
6.	Auditorium			
7.	Canteen			
8.	Trainees Hostel / VIP Rooms			
9.	Students Hostel			
10.	Kitchen – Trainees' + students'			
11.	Dining Halls – Trainees/students			
12.	Hostel Kitchen Grocery Store Rooms			
13.	Hostel Crockery Store Room			
14.	Health Centre			
15.	Play ground			
16.	Staff Quarter Lanes/ surrounding			
17.	Residential Houses			
18.	Matriculation School (BVBV)			
19.	Crèche (Child Care Centre)			
20.	Sports Complex			
21.	Power Room			
22.	Community Hall			

d. The number and location of dump yards in use (within the campus / outside)

e. The menace of dogs, wild boars, and pigs in the campus

f. Identification of unhealthy and unsightly places in the campus

The Results of the Waste Survey

This exercise [waste survey] is carried out in order to get into grips with the data, which shall eventually help in proper planning. Waste survey should be able to give a fairly good estimate of:

- a) Various categories of waste generators in a campus
- b) The types of waste generated by each category
- c) The quantum of waste generated daily / weekly / monthly
- d) Disaggregated data on the amount of wet, dry, hazardous and e-waste generated
- e) The total quantity of waste generated – all streams aggregated
- f) The existing practice of waste collection and disposal
- g) The existing facilities for waste collection, and disposal
- h) The number and location of dump yards in use (within the campus / outside)
- i) The menace of dogs, wild boars, and pigs in the campus
- j) Identification of unhealthy and unsightly places in the campus

How to Use the Results of the Waste Survey

The purpose of waste survey is to help us with data for planning. This is for Institutional Waste Generators. ‘Waste survey’ is a vital preliminary step in commencing any waste management practice or putting in place a system for scientific waste management in a campus. This helps planning the manpower and logistic requirements. This can serve as factual ‘base-line’, which would serve as a counter-factuality to measure the impact after we achieve the indented vision.

STEP – 2

PLAN AND PREPARE

Planning and Preparing Involves:

- a) Principles and Values (that should not be compromised in achieving the vision)
- b) Education and Training
- c) Manpower Deployment
- d) Logistics – (for collection, storage and transport)
- e) Treatment & Disposal

A. Principles and Values

1. **Simple and Replicable:** It is good to bear in view that waste management in a campus need to be *non-intimidating, demonstrable, and replicable*, meaning no big machineries shall be deployed in this process. There shall be only simple, and cost-effective tools and equipment put to use.
2. **Resource Recovery:** We shall test the pragmatism behind the principle ‘*waste-into-resource conversion*’, at the same time we shall not lose sight of the fact that ‘*simplicity is the hallmark of demonstrability*’ and complexity is a drawback.
3. **Green Development:** Any material, machinery or tool required - for waste collection, transport or treatment - shall be identified locally, without having to transport from distant places. In the same vein, ‘waste’ shall not be transported to faraway places for treatment / disposal.
4. **Practice and Support the 5 Rs in Waste Management:** Refuse, Reduce, Reuse, Recycle, and Regenerate (or Re-create)

B. Education and Training

Consider the nature of waste generated by various categories of waste generators in an institutional campus. Two major categories are: (A) Office Buildings where the amount of *dry and e-waste* generation is more, and wet waste tends to be less; and (B) in Residential areas such as hostels, and staff quarters the amount of *wet waste* tends to be more, and the dry and e-waste tends to be less. Obviously, these two groups have to be prepared separately.

1) Office Order: An Office Order must inform clearly about the arrangements being made for scientific disposal of wastes generated in the office, and the responsibilities of officers, clerical staff and the Multi-Task Staff (MTS) in using the right bin for the right purpose. The genitors appointed by the Sanitation Contractor shall clear up the bins every morning.

2) Meeting of Staff & Workers Involved in Sanitation: The Sanitation Inspector under the able guidance of a faculty member shall prepare a draft SWM Plan. Enable the Sanitation Inspector and his team to own up the plan, and finalise it. Any issues to be tackled shall be taken up and resolved before the implementation begins. (Task Description for Sanitation Workers – see Annex -6; and Task Description of Sanitation Inspector, at Annex – 7)

3) Orientation School Children in the Campus: Many school going children reside in the staff quarters. They shall be orientated on the problems of solid waste, and how segregating various types of wastes shall help initiate a practice in scientific management of waste. Explain to them, the SWM plan, and how children can execute IEC campaigns in the staff quarters. This can include resolutions such as: (i) avoiding use-and-throw carry, instead use reusable cloth bags and; (ii) hostels and canteens use only washable / reusable glass tumblers and no use-and-throw cups or paper plates; (iii) no individual plastic water bottles served in the training hall etc. (see Responsibilities of Residents / Households – Annex - 4 Task Description for Hostels, Dining Hall (including canteen) - Annex– 5.

4) Educating the Campus Residents: To begin with there will be a two-hour cultural programme to be organized in a common place. All the residents shall be invited. The cultural programme will start. After about 15 minutes of the cultural programme, Solid Waste Management (SWM) plan shall be put across to the residents. Cultural programme will continue for 30 minutes again. Then, an invited resource person shall take 15 minutes to sensitize the residents on energy and water conservation. At the end of the programme, the head of the institution shall sum up asking for the cooperation of residents for conservation of energy and water; and for proper management of wastes.

5) IEC Campaign by School Children: This campaign is essentially for the residents in the staff quarters. There can be a printed handbill given. Community education must essentially include: what are bio-degradable wastes (wet); and what are non-biodegradable (dry) wastes? Which ones are recyclables; what are hazardous wastes? What is meant by *primary segregation* that the households are supposed to do? What are we trying to achieve and demonstrate through this plan?

6) Training of Sanitation Workers: The sanitation workers must be trained in waste segregation. They must know what primary segregation is; what secondary segregation is; and what tertiary segregation is; how to treat each type of waste; what to do with e-waste; what to do with medical waste; what is the purpose of a Drop-off Bin; and what is the purpose of Material Recovery Facility; and how to deal with habitual non-compliers etc.

7) Orientation to garden maintenance workers and Office Janitors: Generally unfrequented and desolate corners of the campus are vulnerable spots for being used by office janitors to dump garden shrubs and wastes cleared from residential area / office premises. Once begun, the garbage keeps expanding, making the place ‘undeclared dumpsite’. The Sanitation Inspector (SI) is most probably aware of such places. The SI should first of all identify such infamous places / spots; (ii) the garbage heap in such places must be removed to municipality landfills; and (iii) the garden maintenance workers and office janitors should be given orientation to prevent any future misuse, and guide them what should be done with the waste they collect.

8) Community Preparation: Each household must be provided with three different colour bins – Green, Blue and Red. The **Green bin** is for disposing of kitchen refuse, leftover food and other wet waste; the **Blue bin** is meant for keeping dry wastes like papers, cardboards, soap covers etc.; and (c) the **Red bin** is for keeping hazardous wastes like batteries; fused bulbs, sanitary napkins etc. For an illustrative list of wet waste / dry waste / hazardous waste see box – 1 at [annex- 7](#)). There will be a handbill (with pictures) given to each household explaining how to segregate wastes at household level.

(C) Manpower Deployment

An estimation of manpower requirement should be made on an annual basis by every institution. This should take into account the following:

- Area of the Office Complex / Blocks
- Number of Offices / Rooms
- Area of the Open / Common Spaces / Parking area
- Number of Toilets – within Office Blocks and in common areas
- Number of Dining Halls and Canteens
- Area of Parking / Garden

Number of Cleaning Staff for the specific areas (Illustrative) - to be determined as per need

AREA	Number of Sanitation Workers to be deployed
Corridor (Wing A)	Typically 1 worker per floor for 1 – 2 corridors
Corridor (Wing B)	
Toilet Wing (A)	Typically 1 worker per toilet block.
Toilet Wing (B)	
Office Rooms (Wing A)	If corridor level staff available, then nil, else appropriate number of workers may be deployed
Office Rooms (Wing B)	
Sports Complex	Appropriate number may be needed depending upon the size of the building and activities.
Library	
Community Hall	
Health Clinic	
Play Ground / Recreation Centre	
Staff Quarters area	

Sanitation Inspector / Sanitation Supervisor of the Campus shall ensure timely cleaning. Names of sanitation workers in each block should be displayed. Additionally, dedicated supervisors (whose mobile number should be displayed) should be engaged depending on number of cleaning staff, and other locations (e.g. 1 supervisor per wing/floor).

(D) Logistics – (for collection, storage and transport)

(E) Treatment & Disposal

The next step is about facilities required, logistics for collection, including transport and treatment methods. We shall see them in the subsequent sections / steps.

STEP – 3

FACILITY, EQUIPMENT AND LOGISTICS

Facility

Establishing a scientific waste management system in a campus involve certain equipment and logistic facilities. These must be in place before we get started with actual execution of the plan.

The equipment and facilities include:

- Waste bins (of various sizes for different category of waste generators)
- Waste collection cart or vehicle
- Uniforms and safety gears for the sanitation workers
- Waste Segregation shed (which can also be used for parking collection vehicle)
- Facility for treatment of wet waste plus other equipment such as rakes, shovel, hand fork, garden fork, trowel, buckets, wheel barrow, watering can etc.
- Facility for treatment of dry waste (and the residual reject)
- Facility for treatment of hazardous waste (such as an incinerator)
- Storage place for recyclables until they are passed on to recyclers
- Facility for hand-washing / body washing by the sanitation workers

Logistics – Collection and Transport

Solid Waste Management Infrastructure such as waste containers (bins for depositing wastes), collection bins for sanitary workers, Drop-off boxes, transport arrangement, facility for secondary and tertiary segregation, treatment of various types of wastes etc. have to be planned.

Waste Bins need to be planned according to its usages and can be in following categories:

- Paper bins (Under table bins) - size 10 Ltrs
- Waste bins for households at the Staff Quarters – size 15 – 25 Ltrs
- Kerb-side (road-side / pavement-side) Drop-off Boxes - size 50 – 100 Ltrs
- Door to door collection bin of the sanitation workers – size 25 – 30 Ltrs
- Collection bin at the door to door Collection Vehicle – size 1000 Ltrs each colour

Placement of Bins: In a training and research campus where and at what intervals are the bins placed along the internal roads is important. As a norm, at every 100 meters one ‘set of bins’ can be placed. Set of bins indicate bins in different colours for different purposes. In addition every corridor must have at least one or two sets of bins depending on the length of the corridor. Places that are too isolated or too crowded - where people generally tend to discard trash – must be identified, and bins provided in each such spots.

Bin Colour: For easy identification colour coding is also must as indicated (Green, Blue, Red, Black etc.). The Institution concerned can choose the colour as per their choice of interest. Segregation of waste (or disposal of right trash at the right bin) must take place at the users’ level. This must be strictly ensured. Appropriate education / training programme must be taken up until everyone in the campus adheres to the system being created. Display signs / signage for visitors

Infrastructure and Logistic facilities

A. Existing

Assess what infrastructure and logistic facilities are available, and usable. They can be repaired and put to use.

B. Required

	Requirements – One time Investment	Specifications	Approximate price Rs.
1	Waste bins for households (smaller)	10 – 15 Ltrs.	
2	Waste bins for Health Centre & School (bigger)	25 – 50 Ltrs.	
3	Waste bins for Hostels / dining hall (bigger)	25 – 50 Ltrs	
4	Segregation Shed (with three stores rooms)	10 x 10 size	
5	Baskets (for sorting wastes)	25 – 50 Ltrs	
6	Tools and equipment such as shovels, levelers	As required	
7	Ordinary composting /Vermi-beds / NARDEP bed Anaerobic composting (methane plant)	Set up any one as you prefer	
8	Shredder (for shredding before feeding wet waste into the anaerobic compost - methane plant)	10 HP motor operated 100 kg per hour	
9	Incinerator	100 kg per hour	
10	Tri-cycles (solar battery operated) - 2	One ton capacity	

Collection & Frequency

Place of waste collection	Frequency	Timings
Office Blocks, computer centre, library,	Daily	7.30 - 8.30 am
Training / Conference halls,	Daily	7.30 - 8.30 am
Staff quarter lanes	Daily	7.30 - 8.30 am
Road-side / walk-ways / Pavements	Daily (as frequently as required)	7.30 am & 6.30 pm (Clear drop-off boxes)
Hostel Kitchen, Dining halls, Canteen	Not less than twice daily	7.00 am 4.00 pm
Community hall	Before & after every programme / meeting	Weekly cleaning to be done
Health Centre	As Frequently as required	

Covered Transportation: Wheel-barrows and tri-cycles can be used for collecting wastes from various places within the campus. When the quantity becomes bulk, solar battery operated vehicles can be used for transporting solid waste from various places within the campus to the Waste Segregation Shed. During waste collection from various offices and residents and during transport make sure each type of waste is collected separately, and transported separately properly covered so that trash from vehicle do not start floating in air.

Waste Segregation Shed: This is a multi-purpose shed as far as waste management is concerned. All the wastes collected from various places in the campus arrive here. At this stage, secondary segregation takes place, where sanitation workers make sure that wet waste and dry wastes are beyond doubt separate, and that they are not mixed up. Then wet waste goes for its line of treatment. Dry waste goes for its line of treatment. Similarly, other types of wastes also find their respective ways to treatment facility.

Mechanical Devices: Four simple mechanical devices / tools are considered very necessary. They are: (i) Shredders(wet and dry) – to cut garden shrubs and to crush leftover food that are hard such as fishbone, chicken bones etc. before they go into gas plant, or for vermi-composting; (ii) Sieve – to sift raw compost from windrow composting, if they are to be fed into vermi-compost beds.

(E) Treatment & Disposal

Waste Treatment is dealt with separately in Step – 6 of this SOP.

STEP – 4

WASTE SEGREGATION

(+ Secondary and Resource Recovery level Segregations)

Primary Segregation

The most vital element in solid waste management is that the office staff and residents in a campus must use *different colour bins to discard different types of wastes*. This means for example, if general office waste such as used papers go into bin – A; items such as biscuits, food scraps, and used dip-tea pouches must go into bin – B; and used DVDs, and old pen drives must be discarded into a third bin – C. This must be done by the householders at residences, and by the office staff or the concerned Office Assistant at respective offices. The point is wastes when handed over to the Sanitation Workers must be primarily segregated – no mix-ups. If this is in order, it's an indication that everything else can be managed well.

Bins of Different Colours

Waste segregated into three different categories viz. Wet / Dry / Hazardous / E-waste etc. have to travel separately without letting them meet each other at any point during collection or transport. Generally, different colour bins are used for discarding different types of wastes.

	Colour of the bin	What type of trash go in
1	Green	– for wet waste such as food scraps
2	Blue	– for dry wastes such as papers
3	Red	– for hazardous wastes such as old batteries or expired medicines; Plus e-wastes such as DVDs etc.

NOTE: An exhaustive list of trash items that can go into each bins is given at [Annexure - 1 & 2](#)

Residents in the Campus: Provide every household in the campus with bins in three different colour– one for WET WASTE (especially. kitchen refuse); another for DRY WASTE (papers, plastics, bottles, cardboards etc.) and a third one for HAZARDOUS WASTES (old batteries, broken bottles, broken ceramic items, blades, sanitary napkins, diapers etc.). [A long indicative list of these items is given in annexure – 1 & 2.](#)

Secondary Level Segregation

The waste collected from various offices, and residents arrive at the Segregation Shed. At the Segregation shed, the sanitation workers doubly make sure that wet waste that should go for aerobic or anaerobic composting are free from plastic and other non-bio-degradable wastes. Any inadvertent mix-up of dry wastes along with wet waste gets identified here, and segregated. After secondary segregation wet waste is sent for composting – as predetermined.

Dry wastes undergo a tertiary (third) level segregation. This is done for sifting the recyclable waste (metals, bottles, plastics, papers etc.) from dry wastes of no use. After recovering items that can be recycled / or sold to the recyclers, the residual reject is sent for incineration or to a designated sanitary landfill. The waste management vision of every campus should be that the amount of residual waste that reaches the landfill did not exceed 10% of the total waste.

Resource Recovery Level Segregation

Tertiary level segregation aims at recovering recyclable and reusable wastes from the dry wastes. This is also called resource recovery from waste.

Box – 1: What is a Sanitary Landfill?

A common misconception is people show a place being used as *dumpsite*, and they call it *landfill area*. Dumping is neither scientific nor sanitary. Landfill needs to be scientifically done without affecting the groundwater and the environment. There are certain types of non-bio-degradable wastes that cannot be recycled. They may be sent to sanitary landfills. The main consideration while planning for a sanitary land fill is prevention of negative impacts on human health and environment. A low-lying site away from human settlement is selected. A gravel bed is made so as to prevent leaching, if any, not to contaminate the soil nearby or water. After every filling or in periodical intervals a sand cap or clay cap is put on that, which prevents gases such as methane / carbon dioxide from causing air pollution. If we can reduce what ends up in the landfill to 10% to 15% that's fair enough management. Forty five percent may go to gasification plant / composting; and 40% may become recyclables.

STEP –5

REFUSE- REUSE – RECYCLE – RECOVER – REGENERATE

The Five Rs of Waste Management

The 5 Rs of waste management are: Refuse, Reuse, Recycle, Recover and Regenerate. If enough attention is paid every campus in India can implement this principle.

Refuse: Totally ban the use of certain stuff such as use-and-throw carry bags by refusing to use them. This principle can go as an office order. **Box – 2** provides an indicative list of items that can be refused, which the NIRD&PR implements in its Hyderabad campus.

Box – 2: Items a campus can refuse to use, and the proposed alternatives

Refuse	Use, instead
Strongly discourage the use of use-and-throw carry bags. Do not entertain use-and-throw carry bags in the campus.	Use only re-usable cloth bags, jute bags and eco-friendly nonwoven bags.
No polyvinyl flexi banner will be used for making banners	Use only cloth banners – written by an artist or printed
Do not use, nor ask for plastic water bottles in this campus.	Provide safe drinking water through dispensers in all the training halls, dining halls, and in the guest houses.
Stop serving tea / coffee in use-and-throw cups.	Use reusable ceramic cups and plates for serving tea, coffee and snacks.
Strongly discourage wasting of food. Never waste food.	At the dining hall take the quantity you can eat. Leftover food scraps may be discarded in the bin kept for that purpose – Watch out.
Do not litter this campus or any public place. Keep dustbins at every 100 metres in the campus, and in susceptible spots.	Leave any public place cleaner than you saw. Cleanliness is a culture that is contagious. Let it catch on.
Never allow water to be wasted	Water-wise Be wise. Slow the flow
Do not waste electric power.	Switch off lights, fans, and air-conditioners even if you leave your room for a short while.
Avoid giving plastic bouquets for guests	Give only fresh flowers tied with twig threads or cotton threads.
Avoid plastic files / folders in the stationery	Use only recycled handmade papers / cardboards.
Avoid aerated drinks in pet bottles, and beverages in tins and cans	Go for natural juice served in reusable glass
Do not allow cutting trees in the campus. (In any new infrastructure plan, build-in trees).	Any guest visits, or any day of national importance plant trees.

Resolve to ban the use of use-and-throw carry bags, paper plates, and use-and-throw tea cup etc. An indicative list is given above. In a training campus, this can be made known to the trainees and visitors through a small brochure given along with their 'Course Kit' and the same being pasted inside the hostel door, where the participants / guests stay.

Refuse packaged water in one-liter and half liter bottles, aerated drinks, plastic wrapped bouquets, and plastic folders etc. can be completely avoided. They can be outright refused from use in the campus.

Reduce

Reduce taking print outs, use e-office mode and reduce paper files, supply reading materials to trainees in DVDs rather than as printouts (or send daily reading materials using google drive). Send simple office notes by official emails rather than sending signed papers. Reduce power consumption by switching off fans, air-conditioners, and lights when they are not needed. Reduce water use especially by attending to repairs in water closets immediately. Reduce using electricity, and switch to solar as much as possible. Reduce power consumption by replacing old bulbs and tubes with LED and other power-saving lights; replace power-consuming old fans, and air-conditioners. Replace water gushing pipes with water-saving taps and nozzles. Reduce food from being wasted in the hostels, and dining halls.

Reuse

Items we can reuse such as cloth bags, paper bags, even fountain pens, cloth hanky instead of paper towel, water jugs, reusable water jugs / pet bottles, handmade paper files, envelopes, plastic bags of above 50 microns (and dispose the same responsibly for recycling), one-side printed sheets, glass tumblers and stainless steel plates, and tea cups, and stainless steel water tumblers, old papers and files, reuse waste water for gardening and greening (do not allow that to go down the drains).

Recycle

There are Recyclers, Scrap dealers of various products. Get contact details of such dealers / recyclers. They can take back for price, e-wastes and other discarded items including old furniture, air-conditioners, old computers, key boards etc. from office.

Regenerate

The wet kitchen waste, for instance, can help generate methane gas which can be used as cooking gas in hostel kitchen. This is an example of regenerating from wastes.

Prepare Drop-off sites

Each institution can set up two or three 'Drop-off Sites' within the campus especially for enabling the collection of recyclable / and or old items that can be potentially reused. This can take old CDs, DVDs, pen-drives, pens with no refill facility, mobile charges etc. This can be located in two, three appropriate sites.

Prepare Material Recovery Facility (MRF)

Each institution can have one Material Recovery Facility (MRF) where non-compostable office waste can be temporarily stored in order to facilitate segregation, sorting, and recovery of recyclables from various components of waste by authorized informal sector of waste pickers, informal recyclers or any other work force engaged by the institution for the purpose before the waste is delivered or taken up for its processing or disposal.

Get Connected to Extended Producer Responsibility (EPR)

Institutions can also highlight the responsibility of any producer that the post-consumer phase of certain goods must go with the producers, and the delivery chain. Extended Producer Responsibility (EPR) is a policy approach under which producers are given a significant responsibility for the physical collection and treatment or disposal of post-consumer products. This way, most old electronic items, and e-waste can be disposed of suitably without much hassle or hazard.

STEP – 6

WASTE TREATMENT AND DISPOSAL

Waste Streams

Primarily segregated waste from Office Blocks, Hostel Blocks, Residential areas travel in their respective streams and reach the segregation shed for appropriate treatment and disposal. There are different technologies used for treatment of various types of wastes. They are illustrated below.

Wet Waste

Waste especially from kitchen, such as vegetable refuses, food scraps etc. are called wet waste. Send them for composting using one of the methods such as aerobic or anaerobic methods.

- **Aerobic Methods:** Windrow composting, vermin-composting, NARDEP composting are some of the popular methods. See references section of this SOP for a list of useful guides that can explain each of these methods.
- **Anaerobic Method:** Methanation gas generation from kitchen refuse is one widely known method of anaerobic composting methods. Converting food wastes into methane gas (especially from the hostels and dining halls waste) is possible. In addition, the kitchen refuse from staff quarters and hostel dining halls can also be fed into an anaerobic composting plant, which can produce methane for use as cooking gas. Action to set up this plant may be initiated by Sanitation Team.

Dry Waste

Dry wastes must undergo sifting for picking out the recyclables to be passed on to the recyclers. The residual reject are sent for incineration in an eco-friendly incinerator. Generation of electrical energy from incinerated dry waste is possible by addition some simple technologies.

Hazardous Waste

The best approach is to select and use as far as possible only those products which are eco-friendly and environmentally safe. When items such as batteries (dry cell and wet batteries), paints and other household / office chemicals are used, the best thing to do is to approach the supplier to take them back. It is good to find operator of common facility for treatment of hazardous waste, and dispose hazardous waste through such operators. In the absence of such exchange or buy-back arrangement, steps must be taken for environmentally sound management of hazardous wastes.

Care must be taken so as to protect health and the environment against the adverse effects which may result from disposing such wastes. We must make informed decision about which method of disposal would not harm the health or environment. Methods of treating / disposing hazardous waste include shredding followed by deep burial in a landfill, sterilization followed by combustion at 1200 degree Celsius. There are other methods recommended for disposal of bio-medical wastes below, which can also be followed in the case of hazardous wastes.

Waste from Health Clinic

This is applicable not only for health clinics, hospitals, dispensaries, veterinary institutions, vaccination camps, blood donation camps, first aid rooms in an institution, nursing homes but also when an institution conducts medical camps in villages. It is a good practice to send biomedical wastes to Common Biomedical Waste Treatment and Disposal Facility operated by specialists.

- Make provision within the premises for a safe, ventilated and secured location for storage of segregated biomedical waste in coloured bags / appropriate containers.
- Ensure there shall be no secondary handling of biomedical waste, pilferage or inadvertent scattering or spillage by animals.

- Biomedical waste from health centre shall be directly transported to common bio-medical waste treatment facility or for appropriate treatment / disposal.
- Never mix biomedical waste along with municipal solid wastes or other solid wastes to be treated in regular manner.
- Immunize all health care workers and others, involved in handling of biomedical waste for protection against diseases including Hepatitis B and Tetanus.
- Wastes of different types / nature be kept separately for instance sharp surgical blades separate from left over chemicals and tablet strips.
- There are various types of biomedical wastes. For various categories and their segregation, collection, treatment, and disposal options refer to: Bio-Medical Waste Rules – 2016. Bio-medical wastes include: human anatomical wastes, animal anatomical waste, items contaminated with blood and body fluids, expired and discarded medicines, chemical liquid wastes, discarded linens, other clinical laboratory wastes. Most of these can be incinerated at very high temperature (1200 Celsius).
- Some these items require a combination of sterilization, shredding and then incineration. For example, waste sharps / surgical knives must be sterilized, followed by shredding and encapsulating in cement concrete or be sent to landfill.
- Mutilation and shredding must be to an extent to prevent unauthorized reuse.

E-waste

Designate a room in the Campus which may be called ‘Material Recovery Centre’ (MRC). The discarded e-wastes from all the office blocks in the campus shall be sent to the MRC, and stored there until it is sent to e-waste recyclers.

Electronic-waste from office can be discarded in two ways. One way is as mooted by the E-Waste Management Rules – 2016 i.e. Extended Producer Responsibility (EPR). Under EPR manufacturers of computers, and other electronic items should take back end-of-life products. If some Producers / manufacturers want to appoint a ‘Producer Responsibility

Organisation', which - on behalf of manufacturers - collect, dismantle and recycle end-of-life products can do so. Institutions shall use such facility for the disposal of e-waste. The idea is demanding the producers to take back e-waste through the same channel they used for placing a products in customers hands. This can be something like an exchange offer.

Kitchen Waste Management (and Kitchen Sanitation)

Every hostel and dining hall produces waste and stores it temporarily for disposal. Waste must not be allowed to accumulate in working areas or the surrounding environment because:

- Food waste (i.e. food scraps, grease) that is not kept in sealed containers can attract and provide food for pests, worms and insects;
- Other waste (i.e. packaging) that is allowed to build-up provides harbourage for pests and vermin to live in or under; and
- Waste material is a potential source of food contamination. Therefore, how you manage waste to deter harbourage and infestation by pests is vital.
- providing a suitable number of waste receptacles in operating areas for the amount of food and other waste generated;
- Ensuring waste containers are emptied regularly so waste does not build up;
- Providing an adequate number of bulk waste storage containers, with sufficient capacity for the business;
- Ensuring waste containers are suitable for the purpose (e.g. food waste is kept in lidded/sealed containers that are solidly constructed and can be easily cleaned when emptied; cardboard boxes/packaging are broken down and stored off the ground, and either tied together, kept in a cage or compressed into a sealed container).
- Ensuring the different types of waste container are identifiable to ensure correct use;
- Cleaning (and where necessary sanitising) waste containers between use;
- Keeping bulk storage areas clean and free from debris;
- Ensuring bulk waste is removed regularly (e.g. by a specialist waste contractor);

- Ensuring liquid waste and drainage systems operate as intended (e.g. grease traps are cleaned regularly and maintained in accordance with manufacturers' instructions);
- Ensuring gratings are in place to prevent matter entering and blocking drainage; and
- Ensuring any local authority trade waste bylaws are complied with.
- How you protect food and food-contact surfaces from waste contamination, e.g.:
- Ensuring work flow and work practices prevent waste materials and liquids coming into contact with food and associated things, such as food contact surfaces and food packaging materials;
- Ensuring there is a designated area for the storage of waste and that the manner of storage will not cause waste to be mistaken for usable food;
- If appropriate, secure storage is available for potentially hazardous waste and for storage of returned or recalled food;
- Staff understand and put in place good hygienic practices when handling waste (refer to separate guidance on Personal Hygiene and Behaviour).
- Consider the following checks:
- Visual inspection (e.g. checking waste receptacles have lids (where appropriate) and these are used/in place; bins are regularly emptied and are not overflowing; waste storage areas are clean; waste is stored appropriately, drainage grilles/covers for liquid waste are in place and not blocked with food waste or other debris etc.); and
- Observation (e.g. staff dispose of waste appropriately and follow good practices – ie wash hands after handling waste; staff responsible for removing waste from food areas and cleaning containers carry out their duties appropriately). This includes observations with regard to Pest Control as well.

Construction Debris

- Construction and renovation works are regularly taken up in institutions. Where construction wastes / debris generated are more than 20 tons in one-day or 300 tons per project in a month, the concerned contractor (or Engineering Wing) shall

prepare a plan for waste segregation and management and get it approved by the head of the institution along with building plan.

- There can be many streams of waste in a construction site viz. concrete, soil, steel, wood and plastics, bricks and mortar. The daily cleaning or weekly cleaning up plan shall be prepared, and carried out.
- The contractor shall keep the construction and demolition waste within the premise or get the waste deposited at collection centres and hand over to authorized processing facilities of construction and demolition waste. The contractor shall ensure that there is no littering or deposition of construction and demolition waste so as to prevent obstruction to traffic or public or drains.
- The contractor shall remove wastes from work-site at regular intervals or when they are filled, either through own resources or by appointing private operators.

Technical Management

The following are the stages involved in treatment. How to manage waste technically at each stage is presented in the matrix below.

Stage	Technology / Technique	Tools
Stage - 1 COLLECTION		
1.1 From Staff Quarters	Sanitation workers with collection vehicles shall collect as per the area assigned by the Sanitation Inspector	Three bins for every house
1.2 From Trainee Hostels		Three bins
1.3 From Students Hostels		Three bins
1.4 From Canteen		Two bins
1.5 From Office Block - 1		Two bins
1.6 From Office Block - 2		Two bins
1.7 From Office Block - 3		Two bins
1.8 From Health Centre		Three bins (internal management will be Health Centre's)
1.9 From the School		Three bins (internal management will be school's)
1.10 From Training Halls		Two
1.11 From Dining Halls		Two bins
Stage – 2	Wet Waste Management: This is	Pick anything that is not

SECODARY SEGREGATION	especially to ensure that wet waste that will go for vermi-composting or into the gasification plants does not have anything harmful / mix up of plastics etc.	supposed to go into vermi-composting and put them in abasket given (for sending to the landfill).
Stage – 3 TREATMENT OF WET WASTE	Wet Waste Management: After ensuring wet waste does not have any mix up, they are shredded / crushed as it may require, and <u>fed into the gasification plant / vermicomposting bed.</u>	
Stage – 4 TERITIARY SEGREGATION	Dry Waste Management: This is to sift /sort materials that are recyclables and that which must go to landfill.	Pick items (such as bottles, pet bottles, plastics, milk/oil covers, bottle caps etc.) that are salable / recyclable.
Stage – 5 TREATMENT OF DRY WASTE	Dry waste recyclable / salable are kept in stores for sale to <i>kabadiwalas</i> periodically, as decided.	
Stage – 6 TREATMENT OF HAZARDOUS WASTE	<ul style="list-style-type: none"> • Hazardous wastes such as children’s diapers, sanitary napkins, medical bandage, band aid and such items go into incinerator. • Other items such as old batteries, blades, fused bulbs/ tubes, broken ceramic items, rusted tins etc. go to Municipality landfill until an eco-friendly incinerator is installed in the campus. 	
Stage – 7 TREATMENT OF HAZARDOUS WASTE	<ul style="list-style-type: none"> • Safe incineration, sterilization and then shredding before they are sent for incineration. 	Keep them untouched. No secondary handling, except items such as ‘wet cell batteries’ can be returned to producers.
Stage – 8 TREATMENT OF E-WASTE	<ul style="list-style-type: none"> • Material Recovery Centre 	Contact details of dealers in e-waste.
Stage – 9 TREATMENT OF MEDICAL WASTE	<ul style="list-style-type: none"> • Safe incineration, sterilization and then shredding before they are sent for incineration. 	Keep them untouched. No secondary handling.
Stage – 10 TREATMENT OF CONSTRUCTION DEBRIS	<ul style="list-style-type: none"> • Concrete, soil, steel, wood and plastics, bricks and mortar can be stored separately and sent for reuse / recycling at periodical intervals. 	Collection and Storage centre until they are sent for reuse.

STEP – 7

MONITORING AND CORRECTIVES

- 1) **Adherence:** The residents must adhere to segregating waste at source. They must be sufficiently educated. There might be initial hiccups. The sanitation workers must be sufficiently trained in order to educate the residents patiently and stop being put off or discouraged. If primary segregation is properly done, a considerable work for the sanitation workers shall reduce. Ensure households and everyone in the office adheres to proper segregation and cooperates.
- 2) **Feedback from Office Blocks and Residents :** The residents must have the Sanitation Inspector's mobile number to offer suggestions on the system, or make complaints in the event of sanitation workers being irregular or behave irresponsibly.
- 3) **Feedback from Waste Collectors:** The Sanitation Inspector, and the Faculty Coordinator assigned to coordinate implementation of SWM Plan shall talk to the sanitation workers / waste collectors on the response of, and the cooperation extended by the residents /students / hostel. If their intervention is necessary to solve some of the problematic households, or habitual delinquents, they must be attended to.
- 4) **Physical Verification:** The Sanitation Inspector shall make visits when sanitation workers are on duty collecting waste from households and others. It helps solve some of the problems on the spot. Similarly, the SWM Coordination team shall make visits whenever required. Initially the Sanitation Inspector may have to visit street-wise often enough so as to build confidence in the households.
- 5) **Possibility Language:** The Sanitation Inspector should always reinforce amongst the residents (and with the sanitation workers)that we are going to be successful; and own up this operation whole heartedly. He must learn to use only 'possibility language'. Every word he utters that negates this idea is a step in the direction of failure.
- 6) **Corrective Measures:** The SWM Team shall hold monthly meeting (with the Sanitation Inspector and Sanitation Workers) at least for a period of six months until things get regularized and systematized. Such meetings help take corrective measures

required to ground the system, and make it effective. The system can keep improving as months pass by when people appreciate and adhere to the system.

Non-compliance

1. Waste baskets given for SWM purpose shall not be put to any other use, causing SWM to suffer.
2. Where households or some residents are found not abiding by the SWM principles & norms, and are chucking waste mixed up or in some vacant place in residential areas shall be seriously dealt with.
3. In the event of a resident's persistent non-cooperation, the matter will be taken to the notice of the competent authority for advice / action in order to maintain orderliness in the campus.
4. Despite repeated requests and advice, if some residents / students were found not segregating, the Sanitation workers shall do the primary segregation for them, and shall hand a bill of Rs.1500 per month. (Residents not wanting to involve themselves in primary segregation can do so, provided they are prepared to pay Rs.1500 per month to the Sanitary Worker). The same holds good for the caterer in the hostel as well, on a payment of Rs.5000 per month.

Penalty

1. Training cum research campus is a community of highly literate residents. There shall be no need for discussions on penalty. However, anyone willfully or negligently throwing waste in vacant places or hand mixed up wastes persistently shall be viewed as incivility and non-cooperation, and dealt with accordingly.
2. The competent authority may also decide differential way of handling residents in the case of one time violation, and repeated non-compliance / negligence.

General

1. The existing arrangements of office cleaning, cleaning of hostels, toilets and wash basins are not dealt with here. The understanding is they are covered in SOP of the Swachh Office. This plan envisages putting in place a scientific practice in collection, and handling of wastes especially from staff quarters, hostels, and from dining halls. There might be 10% non-classifiable discarded items that may have to necessarily be handed over to the land fill of the municipality. An eco-friendly incinerator can do a great job of burning such reject waste without emitting smoke.
2. The Sanitation Team shall put in place a proper system for solid waste management for the campus. Initial logistics planning and setting up technological requirements shall be taken care of by the team. Adequate community education and community preparation works shall be taken up through IEC activities. Wastes will be collected, converted to gas or properly disposed in a manner that is healthy, ensuring overall cleanliness of the campus.
3. There will be a series of community education programmes conducted with the help of students, either through face to face communication with residents using handbills or by arranging cultural evenings in the auditorium.
4. The Sanitation Team shall constitute a Monitoring cum Review Committee that will periodically review and guide the Sanitation Workers and the Sanitation Inspector (SI). However, the sole responsibility of execution of SWM Plan shall be with the Sanitation Inspector. He shall do the day-to-day planning, assign workers for collection, treatment and disposal of kitchen wastes, and other domestic waste generated in the campus. He must own up the execution part with active support of the Sanitation Team.
5. Solid waste generated by households, hostels, canteen, training halls, within the campus shall be handled by a team of sanitation workers trained and appointed by the Sanitation Inspector with the approval of the competent authority / Director.
6. All technical and community education support will be provided by the Faculty of Sanitation. The day-to-day management will be taken care of by the Sanitation

Inspector, who shall be the main person behind the success of this effort. The gasification plant (proposed for treatment of wet waste) shall be maintained by the agency setting it up under the supervision of a sanitation specialist. The SI shall take appropriate measures towards sustained maintenance of the same.

7. The dry waste after segregation shall be appropriately decided – to sell to the scrap dealers, and to send to municipality landfill / eco-friendly incinerator.
8. Revenue generated, if any, such as from the sale of recyclable items such as bottles, plastics, cardboard boxes etc. shall be used for paying incentive to the workers involved in sanitation task, purchase of uniforms to them, and for the purpose of maintaining pedaled cycle, deployment of additional workers during convocations, *melas* etc.

STEP – 8

PLAN FOR SIGNAGE, HOARDINGS AND PLANTING TREE SAPLINGS

Stickers and Signage

- Waste collection bins must have appropriate stickers indicating what types of wastes go into which bin so that users can use right bin.
- Have pictures as well so that just a notice shall do, rather than having to read instructions.
- Place appropriate signage showing where dustbins are available for someone to locate easily.
- Maintain uniformity of colour in stickers and signage. Yet, too many colours and artistic designs might confuse users. They must help functionality rather than being artistic.

Hoardings & Posters

- Hoardings and posters with sayings and pictures on cleanliness plus certain principles that this campus uphold may be put up for any visitor / trainee / participants of various programmes to appreciate and follow.
- Hoardings and posters ‘do the talking required’ along with the facilities placed for waste segregation, scientific treatment and responsible disposal.

Plant Trees

- Keeping clean and green entail planting trees and beautifying the campus too.
- Plant trees on all national important days
- Arrange to plant tree saplings whenever a VIP visits the campus
- Green and healthy environment doubles out energy, and pep up the mood to deliver great results in whatever work we are engaged in.

STEP – 9

WELFARE OF THE SANITATION WORKERS

- The sanitation workers must be trained properly and sensitized. This can taken place at regular intervals or whenever there is an indication that they need training / orientation.
- They shall also be trained in maintaining the waste collection vehicle, how to make composting, safety in using an incinerator etc.
- Functionality of the waste management system greatly hinges on sanitation workers. Therefore, they must be under watch, and care. Recognize them whenever there is an occasion such as Republic Day, Independency Day etc.
- Generally sanitation work / waste management work is contracted out. Make sure that the sanitation contractor who employs sanitation workers is also orientated, and that s/he treats the sanitation workers as demanded by the agreement.
- In most campuses, these are contract workers, trained for the purpose of SWM. They shall assure to work at least for a period of two years. They undergo periodical training (and exposure as well, if required) in waste handling, occupational safety and waste management. However, do not be complacent things seem to be in place or do not take things for granted that it's theirs [sanitation workers].
- We need to follow up, and be alert about how they perform. In the absence of this, dumping might take place keeping the campus clean. No scientific collection or disposal may take place.
- The sanitation inspector of the campus must be a man with sense. Sanitation Sense is important for the system to get grounded. A cat with gloves does not catch mice.
- The following is an indicative remuneration plan / compensation plan taking into consideration the Minimum Wages Act, and the Solid Waste Management Rules – 2016

Salary: 12,500 per month (Take home salary Rs.11,000 per month)

Insurance Rs.500 per month deducted at source and paid to LIC monthly

Recurring Deposit in the name of the sanitation worker Rs.1000 per month deducted at source and paid to the bank monthly

Monthly health check-up (free primary health care facility at Health Centre)

Uniform, gloves, masks, and shoes

Two pairs of leather loafers (shoes or sneakers) worth Rs.1000 a pair – one in January and the other in July).

Their salary is revisable every two years, provided they are found to be well-mannered and no complaints received of misbehavior including alcoholic behavior.

STEP – 10

REPORTING MECHANISM

Reporting about waste management can be for two purposes – one for internal use and the other for the external world to get to know the results of our waste management effort.

A. Internal

- Records keeping on waste collection, treatment and disposal help better planning in the subsequent years. The quantity of various types of waste collected, and treated can give an idea of what better ‘collection mechanism or treatment mechanism’ could help better recovery of materials sent for recycling or methanation gas generation etc.
- The government rules demand certain items such as e-waste, biomedical waste generated have to be accounted. How much of such wastes were generated, and how they were transported, and treated etc. are required.
- Compare the amount of residual reject that are sent for landfill against our vision of sending not more than 10% to landfill. If the wastes that still go to the landfill are more than 10% that means some more tightening and care is required.

B. External

The whole idea of scientific waste

Refuse

- Number of mineral water bottles refused from being used
- Number of use-and-throw carry bags refused / avoided
- Number of use-and-throw plates refused / avoided
- Number of use-and-throw tea cups refused / avoided
- Number of use-and-throw drinking water paper cups refused / avoided
- Number of plastic files refused

- Number of plastic wrapped flower bouquet avoided
-

Reduce

- Number of printouts avoided / reduced
- Number of gas cylinders reduced by generating methane gas from kitchen waste
- Number of carry bags (even those of above 50 microns) reduced by carrying your own carry bag for shopping
- Amount of waste reduced from joining the mixed up wastes on the streets
- Amount of waste reduced from being handed over to the Municipality

Reuse

- Number of one-side papers reused
- Amount of waste papers sent for reuse as handmade papers
- Number of old furniture refurbished and donated to government run schools for reuse
- Number of discarded old computers, printers, water coolers refurbished and donated

Recycle

- Amount of bottles, plastics, cans, papers, milk and oil covers etc. recovered from dry waste stream and sent for recycling
- Amount of e-waste sent to Material Recovery Facility or to Extended Producer Responsibility Organisations for recycling.
- Support rendered for recycled products by purchasing such items for office use

Regenerate

- Amount of kitchen refuse used for regeneration in the form of methane gas for cooking
- Amount of bio-gas slurry recovered for use in vegetable farms.
- Amount of compost (simple and vermin compost) produced from kitchen refuse.

Annexure – 1

Waste Category

Wet Waste	Dry Waste	Hazardous Waste
Vegetable peels	Soap covers / pockets / sachets	Mosquito repellent refill bottles/ Mosquito repellent mats
Fruit peels	Empty shampoo bottles	Expired medicines
Rotten fruits and vegetables	Empty perfume bottles / containers of deodorants / shaving creams	Tablet covers / Syrups bottles
Leftover food	Milk covers	Any medical discard
Used tea / tea bags	Used door mats/door mats	Sanitary napkins
Used coffee ground	Used tooth brush	Children's diapers
Egg shells	Chocolate wrappers	Used condoms
Coconut shells (including tender coconut shell)	Butter wrappers	Used razor / razor blades
Mango kernel & any seed	Used mop cloth	Old batteries
Coconut fibre	Ghee / oil pockets / cans	Fused bulbs / tubes / electrical items
Used flowers / dry flowers	Package / polythene covers / Plastic covers	Broken glasses / ceramics
Spoiled spices	Newspapers / card boards	Empty cans of toilet cleaners
Floor sweeping dust	cosmetics containers	Expired cosmetics
Meat & non-veg remains	Styrofoam	Cockroach killers / spray cans
Expired bread, biscuits and other food items	Broken stationery like used pens, pencil sharpener	Old printer cartridge / CDs
Hair	Empty cans of floor cleaners	Rusted iron pieces
Garden shrubs	Kurkure / Lays packets	Used odonil bottles
	Unusable shoes /	Old Electronic items / parts
	Sachets (of shampoo, creams etc.)	Pieces of wires, old chargers, old pen drives
	Bisleri kind of water bottles	Old paints / old household chemicals / cleaners
	Used tooth paste tubes etc.	Insecticide sprays / leftovers
	Broken household plastic items / and toys	Toxic rejects
	Metal tins, and cans (e.g Pepsi Coke cans) – Aerosol cans	Cotton/ tissue papers used for medical purpose
	Small tubs like the ones used for yogurt, cheese, jam	
	Pieces of aluminum foils	
	Old brooms, Iron pieces	
	Paper napkins, Tetra packs	
	Destroyed old cushions	
	Leather, rexene, rubber	

List of e-waste

CD/DVDs Pen drives Cables / Wires Phones Cordless phones Cell phones Charges Digital cameras Digital plotters External drives Modems GPS units Hubs Thermostat flasks Calculators Dry cell batteries Electronic scrap parts Mouse / Key board such items Routers Speakers	<u>Other items such as:</u> PCs Laptops Printers TVs (cathode ray tubes [CRTs] in televisions) Air coolers Air-conditioners Fridges Freezers Fax machines Copiers Digital Thermostats CFL tube lights / bulbs Dehumidifiers Fluorescent Lamps and tubes Incandescent Light bulbs Smoke detectors Thermometers
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Task Description for Residents / Households

Clean and Green Campus by 2nd October 2019 is an aspiration, and a splendid dream. In order to move in that direction, we seek the cooperation of the residents by adhering to the following simple steps in handling wastes at your household level. Your adhering to these simple steps shall help our institution to ground a scientific practice in waste management.

3.1 Responsibilities of Households

The following are responsibilities of households / residents

1. Each household shall segregate waste into wet waste (kitchen waste - GREEN) and dry waste (BLUE), and Hazardous Waste (RED), and put in the bin given specifically for each purpose. This is called primary segregation, which will be the responsibility of the residents. The foundation for success or otherwise of this effort absolutely lies at this stage.

Wet Wastes (GREEN): Kitchen-refuse such as vegetable peels, fruits, flowers, egg shells, tea leaves, including leftover food, old bread, fish bones, leaves, garden shrubs, and others easily degradable items.

Dry Wastes (BLUE): plastics, papers, card boards, shampoo bottles, empty cans/tins/toothpaste tube/ worn out toothbrush/ milk covers, oil covers, glass bottles, pet bottles, broken toys, caps of mineral water bottles, iron pieces, etc.

Hazardous waste (RED): Under this category items frequently discarded are: (i) used batteries, (ii) children's diapers, (iii) used-napkins (and such items). Other items under this category could include household chemicals / cleaners / fused bulbs / tubes, broken mirror and broken ceramic items, residual paint/ indoor and farm pesticides, grease, spray cans, shoe polish, expired medicines and other pharmaceutical items / syringes, needles, sharps, blades, rusted tins etc.

Note: It is courteous if we can wrap especially items (ii) and (iii) mentioned under RED waste above in an old newspaper, and stick a small RED colour cello tape (stamp-size enough!) so that it gets appropriate handling without any mess.

2. Vegetable peels, fruit peels, egg shells, used tea leaves, leftover cooked vegetables / food may be put in wet waste bin. But never in a use-and throw cover; never knot it, please. Either give them as such or wrap it only with old newspaper.

3. It is always good to wash inside of a milk pocket with water. Washed milk cover renders it easy for the sanitation workers to deal with it.
4. As far as possible leftover food items such as fish bones, mutton and chicken bones may be given to cats / dogs, if available at the households. This is a way to deal especially with leftover food at household level. If not, these items may be put under wet waste (GREEN Waste), which will go into a gasification plant.
5. Certain items such as sanitary pads, children's nappies, and condoms shall be wrapped in newspapers, or some papers available (put a red X [cross mark]) or stick a piece of RED cello tape, before it is handed to the sanitation workers. Such marking helps easy identification so that the sanitation worker shall handle it appropriately.
6. Please avoid putting used sanitary pads in plastic carry bags and knotting it. They should always be wrapped in old newspapers or some paper available. Similarly, please avoid putting kitchen waste (vegetable peels etc.) in carry bags and knotting it.
7. The sanitation workers (in uniform & cap) shall visit every household with a cart / tri-cycle, and ring a bell to let the residents in that area to get to know that the waste collection vehicle has arrived. It is the responsibility of each household to give the three baskets to the sanitation workers, who shall empty each basket in separate containers they bring / in partitioned vehicles.
8. The residents who repeatedly give mixed up waste (dry /wet / hazardous etc. waste together) shall be classified as Type – 2 residents and dealt with accordingly.
9. Complaints, if any, from the residents may be sent through SMS to the Sanitation Inspector. The residents may also call up the Sanitation Inspector and inform complaints, if any.
10. Similarly, the sanitation workers shall also keep note of residents (House number) who do not cooperate and report to the team assigned to ground this SWM system in the campus.

There are plans in place that the waste collected from residents, after secondary segregation, shall be used for bio-methanation for the hostel kitchen, and for recycling etc. Therefore, if this SWM plan got executed properly and became sustainable, our residents can really set an example to many institutions in the neighbourhood on how to handle household waste intelligibly. We earnestly seek your cooperation, and support.

Task Description for Hostel Manager (including Canteen)

Segregation: The hostel manager to ensure through Room boys and waiters in the dining hall that trainees segregate waste properly. Students in hostel take responsibility to segregate the waste generate in their respective rooms and in the dining hall.

No Plastic Water Bottles: The Hostel Manager shall ensure that no plastic water bottles are provided in the training hall. He shall ensure that water dispensers available in the training halls are filled with purified water. There shall also be a tray with 25 – 30 clean glasses available for participants use. No plastic water Bottles in the campus.

No use-and-throw Items: Only reusable plates, and reusable cups shall be used in the campus. The Hostel Manager shall arrange accordingly.

Water Jugs in Hostel Rooms: The hostel shall supply only water jugs in all the hostel rooms. No water bottles. On day-1, when the participants arrive for training, they shall find the jug in their room, filled with water; and thereafter, they shall fill it themselves whenever required, from one of the water dispensers available in the hostel.

Reduce Wastage: The hostel manager, taking advantage of his vast experience, is encouraged to put in place mechanism to reduce food being wasted in the dining halls.

Waste Bins in the Dining Hall: The hostel manager in arrangement with the caterer shall arrange to send the food waste from dining halls and kitchens to the gasification plant or vermi-compost unit as the case may be. Primary segregation of food waste for possible mix of paper napkins, ice cream sticks, ice cream papers etc. before sending must be made a standard operating procedure.

Waste Bins in the Trainee Rooms: The waste bins in trainee rooms shall be cleaned up regularly. Before the final disposal to the segregation shed, doing a primary segregation shall be the responsibility of hostel. It is the responsibility of the Hostel Manager to arrange for this.

Students Hostels: The students generally are well aware of, and very conscious of the need to segregate waste. Therefore, they shall for sure, adhere to the principles of proper waste management. Each room must be supplied with three bins to enable them do the segregation at their level.

Incinerators: There shall be two incinerators installed – one at the girls hostel, and the other near the segregation shed. This will be used for incinerating sanitary napkins, children's diapers, paper napkins and oily / butter papers etc.

Recyclables: Recyclable items recovered during segregation shall be kept in the store room available at the segregation shed. If the caterer has a way of disposing them in an acceptable manner, he can do so.

Task Description for Sanitation Workers

1. The sanitation workers shall collect waste primarily segregated at the household level.
2. After reaching the **Segregation Shed**, the sanitation workers feed into the **incinerator** (combustion chamber) all the diapers, sanitary napkins and such items handed by households wrapped in old newspapers. This is about the RED bin.
3. Then they turn to handling wet waste: They shall do secondary segregation of the wet waste. During secondary segregation, their main job is ensuring that wet waste donot have any mix up of other types of wastes.
4. Before the wet waste goes into the gasification plant, the workers shall do the necessary chopping, crushing (using the tools installed at the segregation shed) so as to make it fit for feeding into the **gasification plant**. This is the technical arrangement for treating wet waste. This is about the GREEN bin.
5. The workers then do segregation (tertiary **segregation**) of **dry wastes**. The main task here is sorting various materials like plastics, bottles, papers, card boards, cosmetic containers, tins separately. This classification results in grouping items that can be sold to the recyclers (that means what goes for recycling to recyclers), and those items that must be handed over to municipality for their landfill. This will include other hazardous wastes, if any.
6. The items picked from the dry waste for sale to recyclers shall be kept in a store. This will be part of Segregation Shed. Incinerator will also be part of the Segregation Shed.
7. Periodically, it will also be responsibility of the sanitation workers to take out the manure from gas plant, and keep them in sacks.

Task Description for Sanitation Inspector

1. Educate and train the workers on collection, and segregation.
2. Supply uniform, green caps, and other protective gearings to the workers
3. Introduce to the sanitation workers how to use the incinerator; how to use the segregation shed; how to use the chopper / crusher tools; how to use the gasification plant etc.
4. Make periodical plans assigning workers for various tasks in waste management.
5. Make sure that the waste transported by trucks / trailers from one place to another is covered properly and transported.
6. Oversee and educate workers on waste segregation until they become familiar with segregation methods. Arrange for exposure, if required.
7. Arrange segregation and sale of recyclable wastes.
8. Arrange with Municipality to send away landfill waste to take to their landfill.
9. Oversee the type and form of waste fed into the gasification plant, that the garbage are of acceptable type and in acceptable form.
10. Oversee the waste that come from the hostels are in acceptable form before they are fed into the gasification plant / incinerator.
11. Oversee the use of incinerator – how it is used, and what goes in there?
12. Make sure there is no dumping takes place anywhere in the campus by any sanitation worker – either household waste or office wastes or hostel waste.
13. Attend to the complaints brought about by the Sanitation Workers promptly.
14. Ensure the workers get their wages on time, and recommend for incentives from the sale of recyclable items.
15. Ensure the health of the workers through periodical health check-up, and if they use their protective gearings while at work.
16. The sanitation workers should not work overtime, nor should they be allowed to laze around. Calculate and deploy the right number of workers, and they should get one-day weekly off on rotation basis. Along with their monthly wages, they should be supplied toilette - two detergent soaps, and two bath soaps.
17. They should associate their work with cleanliness and as part of preventive health. Their perception of their work should be that they are managing waste scientifically, which is an extremely serious problem world over; and that in the process, they are converting waste into energy, and usable manure. They should not feel small about what they are doing; and no one should be allowed to look down upon them.

Task Description for Material recovery Facilitation Centre at the Campus

Sanitation Specialist (faculty) in the campus shall be involved in setting up the facilities required for:

1. Set up technologies in place:
 - (i) segregation shed
 - (ii) methane gas plant
 - (iii) incinerators – 2 (one for girls hostel and the other along with waste segregation shed)
 - (iv) devices that covert heat energy into electrical energy for illuminating lights at the segregation shed using incinerator heat
 - (iv) shredder machine
 - (v) and a shredder / crusher that crushes mutton-bones, fish-bones etc. before they are fed into gas plant.
2. As part of the segregation shed, three store rooms may be needed - one for keeping recyclable items recovered from dry waste until they are consigned / sold out; second one for keeping e-waste until they are sent for recycling; and a third room for workers to keep their gearing and the tools they use, if any.
3. Set up all these facilities and train the Sanitation Inspector and the Sanitation Workers.
4. Document the progress made in waste management in the campus

**Task Description for the staff in-charge of waste management
in the Health Centre**

- As far as treatment and disposal of biomedical wastes are concerned it is good to approach operator of Common Biomedical Waste Treatment and Disposal Facility.
- The staff in-charge of waste collection and storage must be aware of the type of bag or container to be used for the storage of various types of medical wastes.
- Operate the Incinerator at the Health Centre for disposal of regular medical wastes such as used cotton, bandage rolls etc.
- Use the sterilization or hydroclaving facility for sterilization of some of the wastes before they are shredded and sent to landfills.

The following are some indicative options for storage, treatment and disposal.

Biomedical waste – Treatment and Disposal

Type of medical waste	Type of bag or container to be used	Treatment and disposal options
(1)	(2)	(3)
(a) Human anatomical waste: Human tissues, organs, body parts and fetus bellow the viability period (as per the medical termination of pregnancy act 1971, amended from the time to time.)	Yellow coloured non-chlorinated plastic bags	Incineration or plasma pyrolysis or deep burial. (plasma pyrolysis technology is often referred to as Plasma Gasification which converts organic matter into synthesis gas, which can then be used as a renewable fuel to produce clean power)
(b) Animal anatomical waste: Experimental animal carcasses, body parts, organs, tissues, including the waste generated from animals used in veterinary hospitals or colleges or animal houses.		
(c) soiled waste: Items contaminated with blood, body fluids like dressings, plaster casts, cotton swabs and bags containing residual or discarded blood		Incineration or plasma pyrolysis or deep burial In absence of above facilities, autoclaving or micro-waving/

and blood components.		hydroclaving followed by shredding or mutilation or combination of sterilization and shredding. Treated waste to be sent for energy recovery.
(d)expired or discarded medicines: pharmaceutical waste like antibiotics, cytotoxic drugs including all items contaminated with glass or plastic ampoules, vials etc.	Yellow coloured non-chlorinated plastic bags or containers	Expired 'cytotoxic drugs and items contaminated with cytotoxic drugs to be returned back to the manufacturer or supplier for incineration at temperature >1200 ° c or to common bio –medical waste treatment facility or hazardous waste treatment, storage and disposal facility for incineration at > 1200 c or encapsulation or plasma pyrolysis at >1200 °c . All other discarded medicines shall either sent back to manufacturer or disposed by incineration.
(e) chemical waste: Chemicals used in production of biological and used or discarded disinfectants.	Yellow coloured containers or non-chlorinated plastic bags.	Disposed of by incineration or plasma pyrolysis or encapsulation in hazardous waste treatment, storage and disposal facility.
(f)chemical liquid waste: Liquid waste generated due to use of chemicals in production of biological and used or discarded disinfectants, silver x-ray film developing liquid, discarded formalin, infected secretions, aspirated body fluids, liquid from laboratories and floor washings, cleaning, house-keeping and disinfecting	Separate collection system leading to effluent treatment system	After resource recovery, the chemical liquid waste shall be pre –treated before mixing with other waste water. There are discharge norms to be conformed to.

activities etc.		
(g) Discarded linen , mattresses beddings contaminated with blood or body fluid.	Non-chlorinated yellow plastic bags or suitable packing material.	Non-chlorinated chemical disinfection followed by incineration or plazma pyrolysis or for energy recovery. In absence of above facilities, shredding or mutilation or combination of sterilization and shredding. Treated waste to be sent for energy recovery or incineration or plazma pyrolysis.
(h) Clinical laboratory waste: microbiology, biotechnology and other clinical laboratory waste: Blood bags, laboratory cultures, stocks or specimens of microorganisms, live or attenuated vaccines, human and animal cell cultures used in research, industrial laboratories, production of biological residual toxins, dishes and devices used for cultures.	Autoclave safe plastic bags or containers	Pre-treat to sterilize with non –chlorinated chemicals on-site as per national aids control organization or world health oraganisation guidelines thereafter for incineration.
contaminated waste (recyclable) (a) Wastes generated from disposable items such as tubing, bottles, intravenous tubes and sets, catheters, urine bags, syringes (without needles and fixed needle syringes) and vaccutainers with their needles cut) and gloves.	Red coloured non chlorinated plastic bags or containers	Autoclaving or micro-waving /hydroclaving followed by shredding or mutilation or combination of sterilization and shredding. Treated waste to be sent to registered or authorized recyclers or for energy recovery or plastics to diesel or fuel oil or for road making, whichever is possible. Plastic waste should not be sent to land fill sites.

<p>Waste sharps including metals:</p> <p>Needles, syringes with fixed needles from needle tip cutter or burner, scalpels, blades, or any other contaminated sharp object that may cause puncture and cuts. This includes used, discarded and contaminated metal sharps.</p>	<p>Puncture proof, leak proof, temper proof containers.</p>	<p>Autoclaving or dry heat sterilization followed by shredding or mutilation or encapsulation in metal container or cement concrete: combination of shredding cum autoclaving: and sent for final disposal to iron foundries (having consent to operate from the state pollution control boards or pollution control committees) or sanitary landfill or designated concrete waste sharp pit.</p>
<p>(a) Glassware:</p> <p>Broken or discarded and contaminated glass including medicine vials and ampoules except those contaminated with cytotoxic wastes.</p>	<p>Cardboard boxes with blue colored marking</p>	<p>Disinfection (by soaking the washed glass waste after cleaning with detergent and sodium hypochlorite treatment) or through autoclaving or microwaving or hydroclaving and then sent for recycling.</p>

Community Preparation for SWM at the Campus
(Information, Education and Communication (IEC) Campaign)

The campus residents hold the key for success in solid waste management in the campus. Human propensity to respond to a call for any change generally does not receive the same level of cooperation and support from everyone / every household. First of all, it requires inscribing in their minds that the administration is serious about it; secondly, it should be personally convincing for them to play their part and cooperate; and thirdly what they witness should gradually strengthen their trust in our efforts.

How do we do this? We plan for a series of IEC campaigns to educate the residents on: why scientifically manage solid waste; and how *segregation at the household level eases the entire process of managing waste at subsequent stages*. The responsibilities of the residents are spelt out clearly in the **annexure 3**. Make yourself familiar with this annexure, before you read any further. In this section we shall try to elaborate on how to conduct IEC campaigns for this purpose.

Ultimately, what is expected of the Residents?

- Every household / resident should get habituated to properly segregating waste into three different categories (wet / Dry / Hazardous) before handing them over to waste collectors.

This sounds very simple, but is not easy to make EVERYONE practice it. Thus, the need for IEC.

Information	Education	Communication
<i>(Know what, why and how)</i> Knowledge Awareness Ability	<i>(Self-regulation, Self-correction, Practice, Responsible well-being & civility)</i>	The methods, tools, and techniques (media) used to pass on information, and impact on practice so as to make one behave like an educated person. One can be illiterate but still be ‘educated’

Suggestive IEC Activities

1. **Waste Bins Distribution with handbills:** The Sanitary Inspector shall arrange to supply three different colour bins to all the residents. This must be used as an opportunity to supply also a handbill explaining the purpose of three different colour bins, and seek residents' cooperation, and motivate them, with your reasons: *why this is important in our campus*.
2. **Students Orientation:** The school-going children / students are unstinting source of enthusiastic human resource, the power of which can be tapped for this purpose. To do this, they need a brief orientation on, SWM and what is this plan trying to achieve within the campus. Conduct orientations for them in separate groups, and plan with them how they can involve themselves in this IEC exercise. Generate ideas as well. They can be alternatively used in IEC, IPC activities depending upon their availability.
3. **Cultural Evening:** Cultural evening with messages on waste management; energy and water conservation. Two-hour cultural programme organized in the campus / Auditorium. All the residents shall be invited. In between the cultural programme, we can take 15 minutes to sensitize the residents on waste segregation, energy and water conservation. The cultural programme will continue, then again for 15 minutes Solid Waste Management (SWM) plan can be put across to the residents. At the end of the programme, the head of the institution shall sum up asking for the cooperation of residents for conservation of energy and water; and for proper management of wastes.
4. **IPC (Interpersonal Communication):** This helps in a face to face situation for the students to demonstrate to the residents what are bio-degradable wastes (wet); and what are non-biodegradable (dry) wastes? What are recyclables; what hazardous wastes are? What is meant by *primary segregation* that the households are supposed to do? How this goes further into making gas, vermi-compost etc. which otherwise destroys the environment etc. The students can use their knowledge, creativity and innovation.
5. **SMS Alert:** An SMS alert may be arranged with mobile service providers 'alerting residents every morning with a message on 'waste segregation'. This should go on at least for 15 days at the launch of the programme; then once in three days; and then reduced to once a week.

6. **Educative Information:** The sanitation workers can also politely educate the residents where they mix up waste (without segregating) especially because they are not clear as to how to segregate.
7. **Educative Inspection:** The Sanitation Inspector who goes for monitoring the works of the sanitation workers makes direct observation of how residents respond to the call. He can also use that opportunity to educate the residents who are unaware or are unwilling to spend time on segregating.
8. **Periodical cultural Programmes:** With time memory fades, unless there is a constant refresher taking place. Therefore, as long as a good practice becomes a regular habit with the households / residents, we need to conduct cultural programmes, and periodical visits by school students and sanitation inspector etc.
9. **Announcing Prizes & Gifts:** The residents in the campus who comply 100 per cent with the solid waste management norms, and those who constantly reduce the generation of waste must be identified and recognized on 15th August / 26th January etc. The same holds good about the sanitation workers as well. They must also be constantly encouraged to do a good work.
10. **Rangoli Competition & Best Garden Competition:** The women / *Mahila Mandali* in the campus may be encouraged to participate in gardening and beautification of lanes. This is possible by conducting *rangoli* competition in the residential area, and encouraging residents to grow kitchen garden using waste water. The best *rangoli* and best garden can be given prizes. This will contribute to clean and green campus.