Pre – Feasibility Report

of

Proposed
Integrated Common Hazardous Waste Treatment, Storage and Disposal Facility by
Tamil Nadu Waste Management Limited, Unit-3,
at
Plot No. 141A, 142 & 143, SIPCOT Industrial Complex, Bargur, Pokkampatti (V), Pochampalli (T), Krishnagiri (D), Tamil Nadu

Contents

Pre-Feasibility Report

1.Executive Summary

Industrial Waste Management Association (IWMA) which was formed on the directive of Tamil Nadu Pollution Control Board, has entered an agreement with M/s Tamil Nadu Waste Management Limited (TNWML) to establish an Integrated Common Hazardous Waste Treatment, Storage and Disposal Facility (ICHWTSDF) Unit 3, at Plot No 141A, 142 and 143, SIPCOT Industrial Complex, Bargur SEZ, Pokkampatti (V), Pochampalli (T), Krishnagiri (D), Tamil Nadu. The details of project capacities proposed to be developed are given in **Table 1**.

Table 1

Details of the proposed project capacities

S. No	Description	Proposed Capacities
1	Direct landfill	83.0 TPD
2	Landfill after treatment	166.0 TPD
3	Alternative Fuel & Raw Material facility	83.0 TPD
4	Biomedical waste treatment facility	2.0 TPD
5	Incinerator (common for Hazardous & Biomedical waste)	500 Kg/hr
6	E- waste recycling facility	16.0 TPD
7	Paper recycling facility	2.0 TPD
8	Plastic recycling facility	2.0 TPD
9	Waste oil / used oil recovery facility	2.0 KLPD
10	Spent solvent recovery facility	5.0 KLPD
11	Used lead acid battery recycling facility	5.5 TPD

As per the notification issued by the Ministry of Environment and Forests, Climate Change (MoEF&CC) S.O.1533, dated 14.09.2006 and its subsequent amendments, the proposed project falls under Project Activity 7(d) - Common Hazardous Waste Treatment, Storage and Disposal Facilities (TSDFs), Category 'A' - All Integrated facilities having incineration and landfill or Incineration alone.

The total land allotted for the proposed project is 25 Acres (10.11 Ha). At any given time, an area of 33% will be allotted for greenbelt development to meet MoEF&CC guidelines. A minimum area of 10 m width will be left for greenbelt development all along the boundary and one row of plants (both sides) will be planted along the internal roads within the project site to minimize the environmental impacts of the site on its surroundings.

The total water requirement for the project is 170 KLD. The water will be sourced from South Pennaiyar River/ borewells/ tankers. The power required for operations is 1500 kVA which will be taken from Samalpatti power corporation/TNEB. Two DG sets of 200 kVA and 300 kVA capacities will be used as backup power during emergency requirement.

The capital cost for the proposed project is estimated to be around Rs 80 Crores. The capital cost allocated for EMP is around Rs 9 Crores with a recurring cost of Rs 1.50 Crores/annum.

2. Introduction of the Project

2.1 Identification of Project and Project Proponent

2.1.1 Identification of Project

Tamil Nadu Waste Management Limited has the credit and distinction of experience in operating hazardous waste management facility in Tamil Nadu. The group today is the leader in waste management in the state. TNWML has established two TSDFs- one at Gummidipoondi and another at Madurai on Build, Own and Operate basis. The company offers high quality un-interrupted services at competitive prices. TNWML is focused both in the fields of industrial hazardous waste management as well as biomedical waste management. With this vast experience and expertise available, TNWML is proposing to establish an ICHWTSDF at SIC Bargur in compliance with the statutory guidelines. All the operational data and expertise of the established plants will be made available to the newly proposed facility.

2.1.2 Project Proponent

The proposed project will be established and operated by Tamil Nadu Waste Management Limited (Ramky Group) in association with IWMA.

2.2 Brief Description of Nature of the Project

The project proposed is an Integrated Common Hazardous Waste Treatment, Storage and Disposal Facility (ICHWTSDF) at SIC Bargur, Pokkampatti (V), Pochampalli (T), Krishnagiri (D), Tamil Nadu. The project is proposed to treat hazardous and biomedical wastes, AFRF and recycling of paper, plastic, E-waste, used lead acid batteries, spent solvent and used oil. The project activities consist of collection, transportation, treatment, storage and disposal of various types of wastes.

2.3 Need for the Project and its Importance to the Country and Region

With the new initiatives of the State Government of Tamil Nadu, on rapid industrialization in various districts of the state, it is likely that the increasing quantity of waste necessitates the establishment of TSDFs with provisions for treatment, storage & disposal of various wastes in different parts of the state. The proposed facility will be established in accordance with the applicable rules and guidelines issued by MoEF&CC for catering the needs of industries and other units at Krishnagiri district as well as its neighboring /nearby districts.

A major concern about the hazardous wastes is that, they need to be disposed of in a secured manner in view of their toxic nature, environmental pollution and wide range of health hazards. At present, the waste generated from industries, commercial and residential activities are either indiscriminately disposed in open areas/within their units/given to small recyclers. However, some waste generators find it difficult to dispose

their wastes without causing environmental disturbance, as very few appropriate disposal facilities are available.

The Government of India has promulgated rules for handling various types of wastes through MoEF&CC under the aegis of Environment (Protection) Act, 1986 during different periods, the details of which are given in **Table 2**.

Table 2

Details of the Rules framed for handling of various solid wastes

Solid Wastes	Year in which the Rules are framed	Details of Amended Rules
Hazardous Chemicals	1989	The Manufacture, Storage and Import of Hazardous Chemical rules , 2000
Bio Medical Waste	1998	Bio-Medical Waste Management Rules, 2016.
Municipal Solid Waste	2000	Solid Waste Management Rules, 2016.
Hazardous Wastes	2008	Hazardous and Other Wastes (Management and Transboundary Movement) Rules, 2016.
E-Waste	2011	E-Waste (Management) Rules, 2016.
Plastic Waste	2011	Plastic Waste Management Rules, 2016.
Battery waste	2001	Batteries (Management & Handling) Amendment Rules, 2010

Having an integrated facility would minimize the risk involved in waste transportation and waste movement. Further, the project will facilitate a one stop solution for management of all types of wastes at a common treatment facility. The wastes would be collected from the waste generators, treated as per their characteristics and finally disposed of, meeting MoEF&CC guidelines and standards.

2.4 Demand Supply Gap

Due to rapid industrialization, the generation of waste all over the country is growing proportionally. The proposed project will meet the needs of industries, commercial establishments and Health Care Units (HCUs) situated in Krishnagiri district and other neighboring districts of Tamil Nadu.

Hazardous waste inventorization of Tamil Nadu

The present hazardous waste inventory scenario of Tamil Nadu (given by Tamil Nadu Pollution Control Board, TNPCB) is given in **Table 3.**

Table 3

Hazardous waste inventory of Tamil Nadu

No. of Haz waste generating units	Lanfillable (Lakh tonnes)	Recyclable (Lakh tonnes)	Incinerable waste (Lakh tonnes)	Total quantity (Lakh tonnes)
3545	2.97	3.42	0.52	6.91

(**Source**: http://www.tnpcb.gov.in/hazardous-waste-managment.php)

The two TSDFs already established by the proponent (Gummadipoondi and Madurai) are receiving the wastes generated from some major locations in Tamil Nadu as shown in **Table 4**.

Table 4
Quantity (MTPA) of hazardous waste generated

Locations	No of units	Disposable waste	Incinerable/ AFRF waste	Recyclable waste	Total
Perundarai	186	6045	735	655	7621
Erode	173	13119	0	1279	14571
Karur	73	6314	0	752	7139
Salem	135	7956	2209	3784	14084
Coimbatore	89	6661	340	3909	10999
Tiruppur	293	54887	0	86295	141475
Namakkal	125	2226	3	687	3041
Total	**1074**	**97208**	**3287**	**97360**	**198929**

Biomedical Waste

The Private and Government hospitals in Tamil Nadu have made an agreement with the Common Biomedical Waste Treatment Facilities (CBMWTF) for the collection, transport, treatment and scientific disposal of biomedical waste. **Table 5** shows the current scenario of BMW inventorization in the state.

Table 5
Biomedical waste scenario of Tamil Nadu

No. of private & Govt hospitals authorized by TNPCB	No. of CBMWTFs presently in operation	Average BMW handled (Tonnes)
6261	11	43

(**Source**: http://www.tnpcb.gov.in/bio-medical-waste-management.php)

Considering the waste generation scenario and the facilities available to accommodate the increasing amount of wastes, a need was felt to establish an ICHWTSDF to treat and dispose the wastes generated from the industries and HCUs in and around krishnagiri district in a scientific manner meeting the guidelines issued by MoEF&CC. The proposed facility will be unique and bridge the yawning gap in the demand and availability of hazardous waste management facilities in the country.

2.5 Imports Vs. Indigenous Production

The project is proposed for the treatment and disposal of various wastes generated by industries, commercial establishments, HCUs etc. Hence, imports Vs. indigenous production are not applicable for this project. On the contrary, the recycling units proposed for paper, plastic, E-waste, used lead acid batteries, spent solvent and used oil can reduce the demand for virgin materials.

2.6 Export Possibility

The proposed project being a treatment and disposal facility does not generate any products suitable for export.

2.7 Domestic/Export Markets

The recycled materials (paper, plastic, E-waste, spent solvents etc.) produced from the proposed project can meet the demand of domestic market to a certain extent.

2.8 Employment Generation (Direct and Indirect) due to the Project

The direct and indirect employments envisaged from the proposed project for both skilled and unskilled are given in **Table 6.**

Table 6

Details of Manpower

S.No	Description	Direct	Remarks
1	Administrative	15	Indirect employment during operation will be around 100 persons During establishment period, around 200 persons at peak period
2	Skilled Manpower	35	
3	Unskilled Manpower	50	
Total		**100**	

3. Project Description

3.1 Type of Project including Interlinked and Independent Projects, if any

The proposed project is aimed at establishing an Integrated Common Hazardous Waste Treatment, Storage and Disposal Facility for the treatment and disposal of hazardous wastes, biomedical wastes and recycling of E-wastes, plastic, paper wastes and spent solvents etc. This will provide a one stop solution for the treatment of various types of wastes on a common platform. There are no interlinked projects.

3.2 Location (Map showing general location, specific location, project boundary and project site layout) with coordinates

The site is located at Plot No. 141A, 142 & 143, SIPCOT Industrial Complex, Bargur SEZ, Pokkampatti (V), Pochampalli (T), Krishnagiri District, Tamil Nadu. The co-ordinates of the site are given in **Table 7**. The location map of the site is given in **Figure 1** and the site layout in **Figure 2**.

Table 7

Coordinates of the proposed site

S. No.	Longitude	Latitude
1	78° 24' 55.644" E	12° 18' 44.802" N
2	78° 24' 48.867" E	12° 18' 33.613" N
3	78° 24' 41.848" E	12° 18' 37.462" N
4	78° 24' 42.577" E	12° 18' 38.691" N
5	78° 24' 43.241" E	12° 18' 44.663" N
6	78° 24' 46.937" E	12° 18' 44.212" N
7	78° 24' 50.420" E	12° 18' 48.309" N

3.3 Details of alternate sites considered and the basis of selecting the proposed site, particularly the environmental considerations gone into should be highlighted.

Since the proposed project is located in the land allocated in SIPCOT industrial complex Bargur, no alternate sites have been considered. However, the site is evaluated and selected based on the analysis of site selection criteria and knock-out criteria of MoEF&CC and site evaluation criteria as per CPCB guidelines HAZWAMS/25/2002-2003. The complete evaluation of the site is given in **Annexure 1.** Based on the analysis of site evaluation criteria, the site got a weightage of 71.7 on a scale of 100 and it is falls under class GOOD.

3.4 Size or Magnitude of Operation

The project is proposed in an area of 25 Acres (10.11 Ha) for establishing an Integrated Common Hazardous Waste Treatment, Storage and Disposal Facility for the treatment and disposal of hazardous wastes, biomedical wastes, AFRF and recycling of E-wastes, plastics, paper, used lead acid batteries, spent solvent and used oil etc.

Figure 1

Location Map

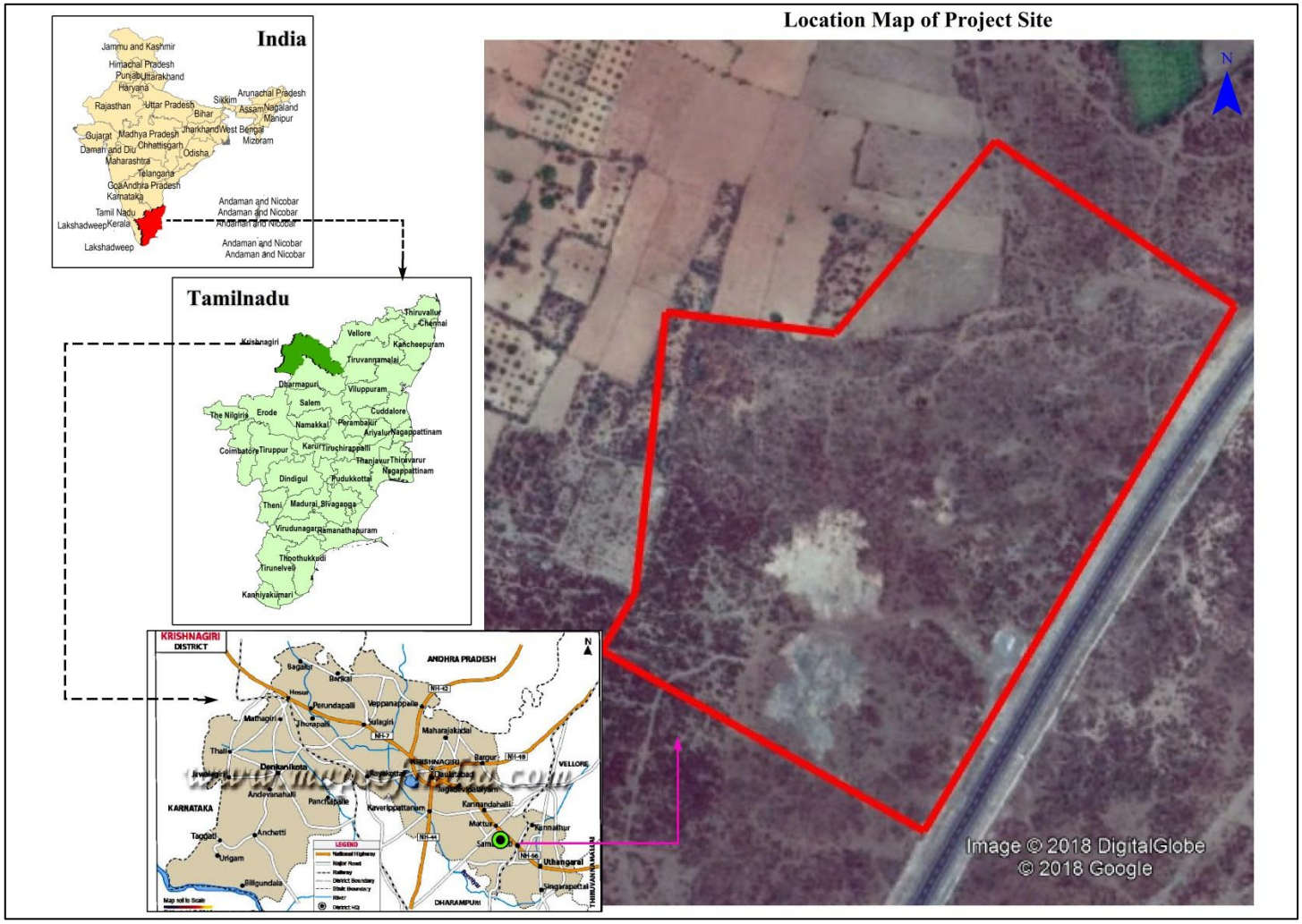
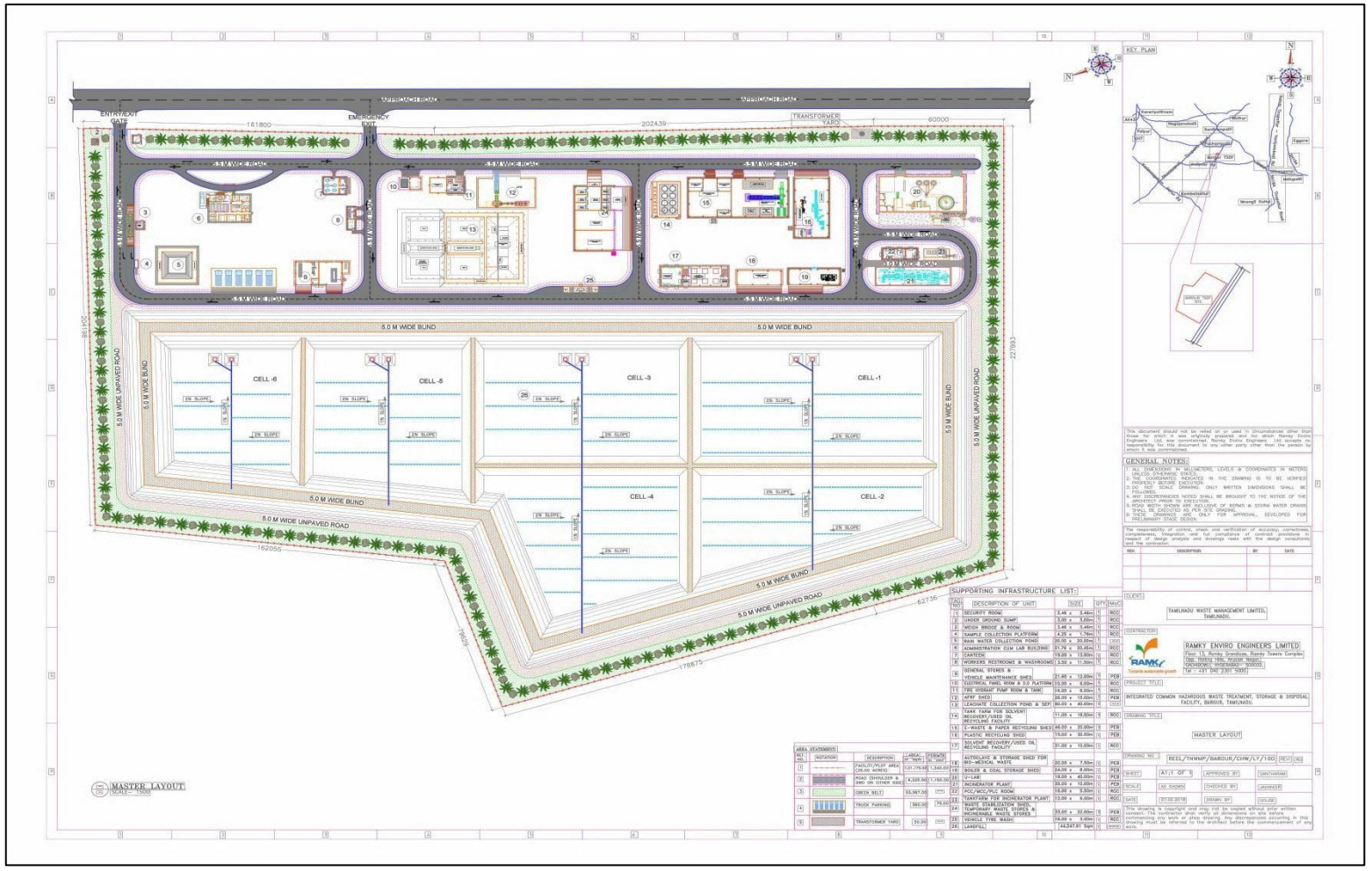


Figure 2

Site Layout



3.5 Project Description with Process Details (A schematic diagram/ flow chart showing the project layout, components of the project etc. should be given)

The proposed integrated facility has four principle unit operations viz. physico-chemical treatment units, biomedical Incineration plant, scientific engineered secured Landfill and recycling facilities. In addition to these, there shall be permanent and temporary storages interim storage for intractable/ incompatible wastes, respectively. The facility shall also have provision for waste reuse/ recycling of waste that have potential uses after suitable treatment. Supporting infrastructure like wastewater and leachate management plant, air pollution control system, other pollution abatement units, laboratory, utilities, waste collection and transportation system, workshop for maintenance of plant machinery, automobile maintenance workshop and electrical maintenance etc., shall be provided. Administrative infrastructure required for operations of the facility will also be provided.

3.5.1 Hazardous Waste Management Facility

The facility is proposed to handle the following categories of hazardous wastes:

- ETP sludge
- Iron sludge
- Still Bottom residues and process sludge
- Spent Carbon
- Evaporation salts/ other process salts
- Incineration ash
- Slags
- Asbestos and glass fibres
- Spent catalysts and resins
- Other hazardous wastes

Depending on the nature and characteristics of hazardous waste, pre-treatment is given to the waste and disposal methods have been proposed as given below:

- ETP sludge can go to landfill either directly or after stabilization.
- Depending on the characteristics of the impurities, bottom residues, process residues and other organic wastes including spent carbon can be sent for incineration.
- Incineration ash, slags, asbestos and glass fibers are essentially inorganic in nature and can go to landfill directly or with simple stabilization techniques.
- Spent catalysts and resins would have to be characterized on a case-by-case basis to assess their nature and characteristics. However, the percentage of wastes generated through these sources is likely to be very small as most of it is taken back by the manufacturers.
- Salts will have to be bagged and landfilled.
- Based on the above compiled information wastes have been classified by their pathway of disposal:

- Wastes going to direct landfill
- Wastes that require stabilization prior to landfill
- Wastes requiring storage until alternate economically viable techniques are made available.
- Wastes requiring incineration

The following general guidelines shall relate to daily activities associated with the operations of TSDF:

- The secured landfill facility shall operate only during day.
- The landfill will be filled progressively, cell wise and capped to minimize infiltration of wastes.
- The weigh bridge at the main entrance will record all movements and weights and receive waste tracking receipt as required by the waste manifest system.
- The standpipe forming part of the leachate collection system shall be checked regularly for the presence of leachate. Once leachate is detected, it shall be regularly pumped out and transferred to the leachate treatment facility on-site. The level of leachate in the standpipe shall not be allowed to rise above the level of the leachate collection system.
- Materials Safety Data Sheets (MSDS) for every chemical used or handled at the landfill shall be provided at the premises.
- Monitoring and auditing of the facility shall be performed periodically as per CFE issued by CPCB.
- Meteorological station shall be installed with continuous recording system.
- A security system shall be maintained to avoid trespassing of public.
- Once waste is received at the site, a sample of waste shall be collected at the sampling bay/temporary storage facility and shall be subjected to laboratory analysis based on which its pathway of treatment/ disposal shall be determined.
- A waste manifest system shall be developed in accordance with the requirement of the regulatory agencies to cover transportation of waste to TSDF and to provide for record of waste manifestation. The manifest system shall include details of the waste generator, waste transporter, quantity of waste, characteristics of waste, description, consistency of waste in terms of physical state and waste category number as per Hazardous and Other Wastes (Management and Trans-boundary Movement) Rules, 2016 and subsequent amendments
- Each load of waste arriving at the facility shall be located properly and logged to identify its pathway of treatment/ storage/ disposal.
- An inventory shall be maintained at the arrival and departure dates of waste loads in and out of the intractable waste storage area.

3.5.2 Waste Disposable Operations

3.5.2.1 Waste Stabilization

Waste stabilization is designed to convert industrial wastes in the form of liquids, semi-solids or reactive solids into low leachable materials that can be deposited into a secured landfill. The stabilization operation will be carried out for all wastes that require this step to minimize their contaminant leaching potential. This will change the nature of these wastes to a less hazardous category. Stabilization involves the immobilization of leachable materials by fixation as non-reactive solids. The treated wastes shall be assessed for compatibility with other wastes before being landfilled and for compatibility with the HDPE and the pipe network. Stabilization covers a number of mechanisms including:

- **Immobilization / Chemical Fixation** – Chemical binding of contaminants within a cementing structure to reduce the mobility or leachability of the waste.
- **Encapsulation** –Entrapment of contaminant particles within a solid matrix.
- **Solidification** – Conversion of slurries that do not readily de-water into solids by addition of adsorption agents.

Treatment facility utilizes a range of techniques and processes designed to change the physical, chemical or biological characteristics of the waste. This may include changing the composition so as to neutralize the waste, recover energy or natural resources from the waste, render the waste non-hazardous or less hazardous, safer to transport, store, dispose of or to reduce its volume. Typical reagents used, the infrastructure proposed and operations for waste stabilization unit are presented in **Table 8.**

Table 8

Reagents, infrastructure and operations for waste stabilization unit

Typical reagents	Infrastructure	Typical operations
Cement, lime, fly ash, bentonite clay, saw dust Sodium silicate solution would be used as an additive binding agent wherever required	• Storage facilities for regents • Tanks/Drums for storage of reagents as required • Stabilization bins for mixing the wastes • Earth moving equipment for movement of wastes and mixing. • Place for curing the treated waste • Trucks for hauling the wastes.	• Receiving the waste • Addition of reagents • Mixing • Curing • Analysis of the stabilized wastes • Approval by laboratory for disposal • Transfer of waste materials to the truck • Disposal in landfill

Application criteria: A study of the waste characteristics carried out as an integral part of the project indicates the following applicability to the process as shown in **Table 9.**

Table 9

Stabilization mechanism based on waste characteristics

Mechanism	Applicability
Immobilization / Chemical Fixation	• Heavy metal and metal plating sludge • Copper-chromium-arsenic wood preservative wastes • Mercury waste • Bag house dust • Tannery wastes • Spent catalysts and others
Solidification	• Effluent treatment plant sludge • Oil and paint sludge • Bitumen wastes • Textile industry sludge • Wool scouring slurries
Encapsulation	• Aluminum powder • Asbestos • Filler aids

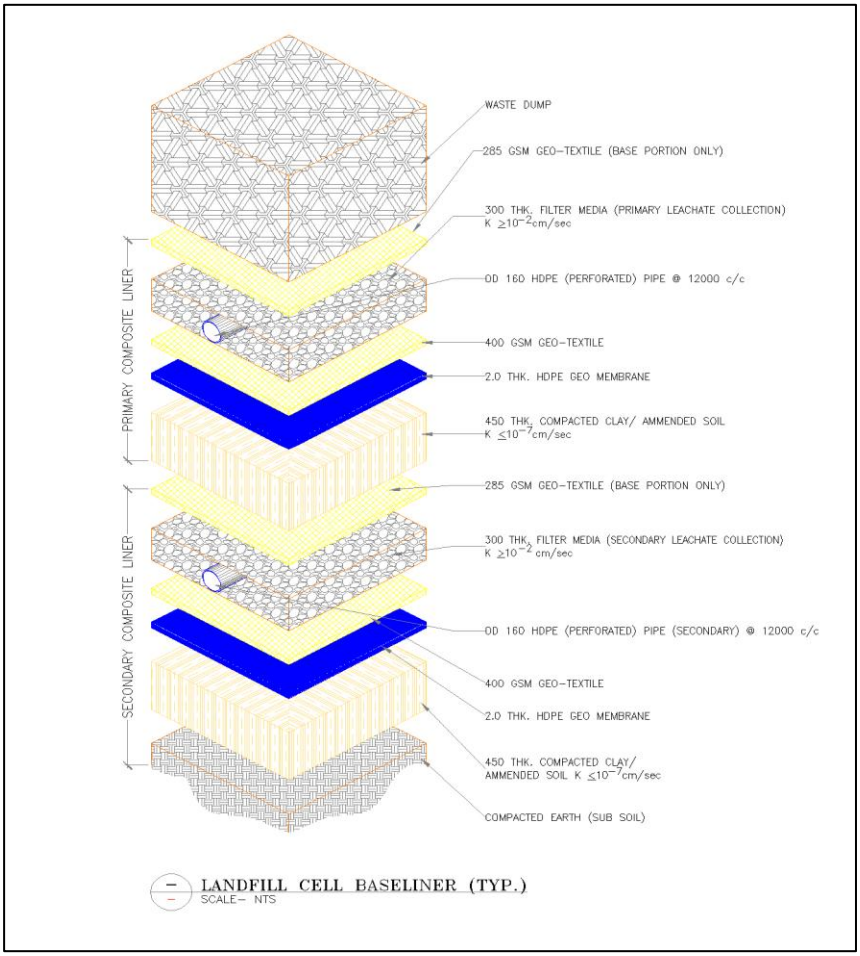
3.5.2.2 Secured landfill

Secure landfill is the final placement area for land fillable hazardous wastes which are treated or wastes does not require treatment. Waste directly or after treatment will be disposed in the landfill as per the laboratory advice. The landfill will be designed and constructed as a secured facility to contain the waste material and any leachate, which is formed by the entrapped moisture or by infiltration of rainfall. To meet these requirements, the base of the landfill has been designed as an engineered liner constructed prior to the placement of waste and also an engineered capping over the surface after completion of filling so as to minimize the infiltration of rainfall.

The base liner of the landfill containment system is proposed to be a double composite liner with synthetic geo-membrane plus clay. Adequate leachate collection system shall be incorporated at the base to collect and remove the leachate. These shall incorporate HDPE pipes embedded in drainage layers of sand/ gravel and /or geonet/ geotextile. The composite liner (Secondary liner) shall comprise of a 0.45 m thick clay compacted to a permeability less than 10^{-9} m/s and above this shall be a HDPE liner with permeability less than 10^{-14} m/s above which a complete drainage system shall be placed. Above the secondary base liner shall be placed a primary liner comprising of primarily clay layer and HDPE membrane which will prevent infiltration into the secondary layer. A leachate collection and removal system shall also be placed over the primary liner to collect and remove any leachate generated by infiltration of precipitation or by the moisture entrapped in the waste. This makes the secondary system to serve as a leak detection system and an early warning of potential future liabilities to necessitate action for remediation. Above the drainage system of the primary liner shall be placed a geo-textile filter to act as a filter/ barrier between the waste and the drainage system. This entire

system would make the base liner a double composite liner meeting the national laws. The detailed landfill cross section as per CPCB guidelines is given in **Figure 3.**

Figure 3
Landfill Cross Section



Waste will be spread in the landfill using heavy earth machinery and then compacted using vibro compactor. At the end of the landfill operations 10^{-15} cm soil cover is placed as a daily cover. During rainy season a flexible geo-membrane cover shall be placed over the uncapped area of the landfill minimize infiltration of rainfall into the landfill; the rain water shall be diverted to join the surface water drains. At the end of the total landfill operations the final capping shall be done using composite liner with clay and synthetic geo-membrane, with vegetative soil cover grass cover.

3.5.2.3 Leachate Collection/Treatment and Disposal

Leachate collection and removal shall be provided above the geo-membrane in two layers viz., the primary and the secondary liners. The primary liner shall serve as leachate collection and removal system, while the secondary liner shall serve as leak detection system and a signal of potential liabilities in terms of environmental pollution. Leachate shall be collected by a network of lateral and header pipes embedded in a drainage layer,

all of which shall eventually drain into a leachate collection sump. The collected leachate shall be transferred to a leachate treatment system.

The leachate collection system in an engineered landfill takes the form of an under-drain beneath the waste material it is required to ensure there is no more than a limited head of pressure above the base liner to cause leakage of liquid from the base of the landfill. The design maximum pressure head in the proposed landfill shall be limited to 300mm.

Drainage is affected by a layer of about 300mm thick of graded sand/gravel having a high permeability. Within this layer a network of HDPE pipes are placed to collect leachate and conduct it quickly to the collection sump for removal from landfill. The pipes are typically perforated only over the upper half to allow the leachate to enter the pipe and thereafter to be contained within the pipe network system. The layout of the pipe network generally includes sufficient redundancy to ensure that if a blockage occurs somewhere in the network the leachate simply backs-up a little then flows into the system a little further up-gradient. Two layers of the leachate collection system shall be provided one over the other. Slotting area of the pipe shall be done only on the top 120 portion of the pipe and to an extent of 100 cm^2 per running meter of the pipe.

The key design features of the leachate collection system to be installed at the proposed landfill comprise the following:

- A network of semi perforated HDPE pipes laid out directly over the primary and secondary liners and graded towards the collection sump at no less that 2% slope, with a slotting area of 100 cm^2 per running meter of the pipe.
- A drainage layer 300mm thick of graded sand/gravel placed over the entire base of the landfill, covering the pipe network.
- A geo-textile placed over the primary liner serving the purpose of filter/ barrier between the waste and the drainage media.
- The pipe shall have sufficient strength to withstand the load imposed by the overlying waste and the earth moving activities associated with the placement and the compaction of the waste (Min 6 kg/ Sq.cm).

Drainage of Surface Runoff

Network of open channels shall be designed and constructed around the landfill to intercept surface runoff of rainwater and divert it around the facility or collect it for the use at the facility or for disposal. Storm water collected on the landfill site will be directed to a first flush retention pond which shall be designed for a sufficient capacity to cover a 1 in 100 years 10 minutes storm event. In particular the storm water system will be designed and implemented to prevent surface runoff entering the landfill and thus minimizing the leachate.

3.5.3 Incinerator

Incineration is a treatment process, applied to certain wastes that cannot be recycled, reused or safely deposited into a landfill. It is a high temperature, thermal destruction oxidation process in which hazardous wastes are converted in the presence of oxygen in air into gases and incombustible solid residue. The gases are vented into the atmosphere with cleaning as deemed necessary while the solid residue is sent to landfill for disposal. The proposed incinerator would facilitate treatment of following wastes:

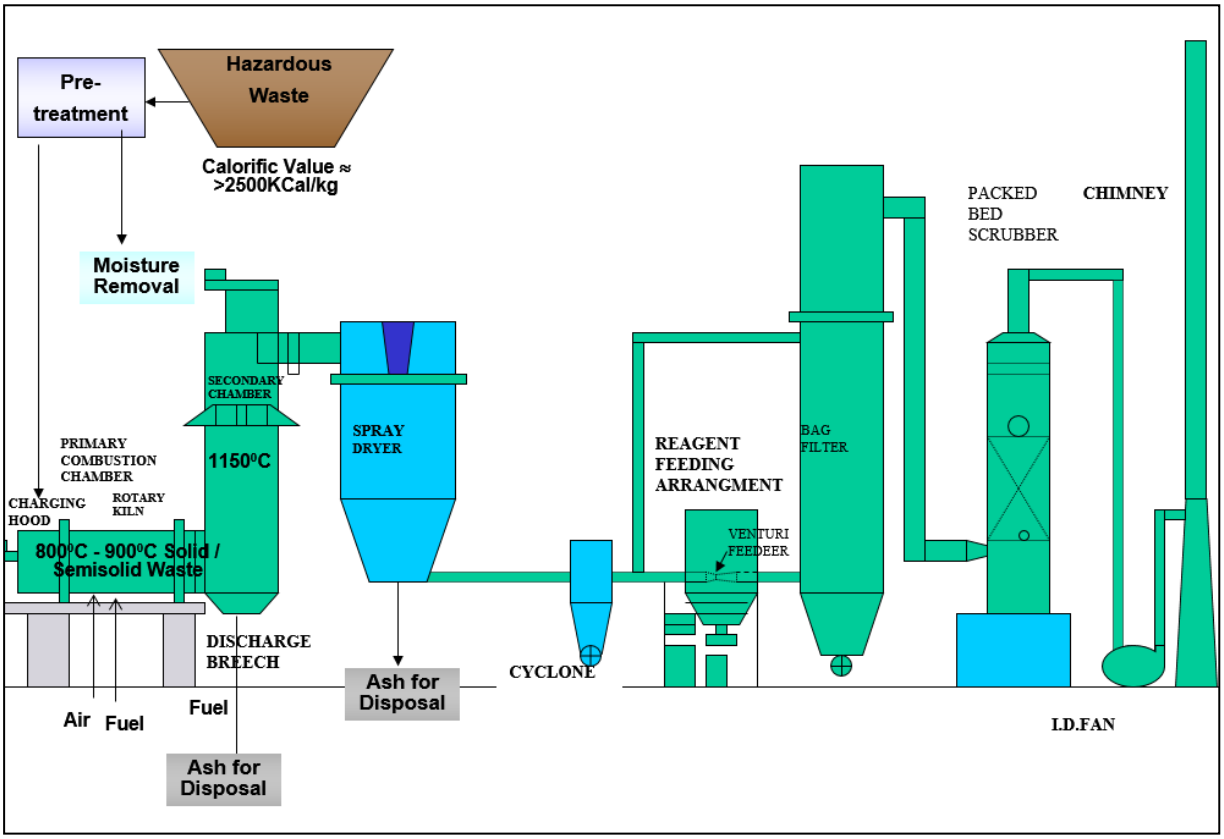
- Bio-medical wastes
- Spent solvents
- Waste oils, oil emulsions and oil mixtures
- Pesticide wastes
- Refinery wastes
- Pharmaceutical wastes
- Phenolic wastes
- Grease and wax wastes
- Organic wastes containing halogens, sulphur, phosphorous or nitrogen compounds
- Solid materials contaminated with oils.
- Organics with high calorific value

TNWML intends to set up an incinerator (500 Kh/hr capacity) at Bargur. The unit shall be a dual chambered incinerator.

The primary chamber's main purpose would be combustion of waste materials into safe end products (ash). The temperature of the primary chamber would be minimum 800 ^{0}C wherein wastes are completely destroyed. The primary chamber would have an attached burner with auxiliary fuel supply to augment the fuel requirements and ensure maintenance of temperatures. The purpose of the secondary chamber would be to burn the off-gases and ensure safe end products (gaseous). The secondary chamber would operate at a temperature of 1050^{0}C ± 50^{0}C and above. The gases would be completely burnt and safe gases then shall be let out of the incinerator unit. The incinerator is completely automated with control panel and continuous recording of temperatures. The entire system is very simple and is easy to operate. The incinerator will be equipped with air pollution control system including: quencher, venture scrubber and wet alkali scrubber followed by ID fan with 30 m stack. The typical layout of incinerator is shown in **Figure 4**.

Figure 4

Typical Layout of Incinerator



3.5.4 Bio-medical Waste

With increase in population, the medical care facilities have also increased tremendously and proportionately the amount of Bio-medical waste generated. The concern about disposal of BMW generated by the hospitals is increasing rapidly due to the fear of the spread of infectious diseases. A scientific approach is therefore required to manage these wastes. It is also essential that professionally trained personnel should handle the wastes and dispose in a scientific manner.

In order to regulate the environmental threat due to mismanagement of BMW, the MoEF&CC, Government of India, has notified the Bio-medical waste (Handling & Management) Rules in 1998, which were amended in 2003, 2011 and 2016. But, all Health Care Units (HCUs) cannot afford to set up treatment and disposal facilities due to the high costs involved. Therefore the need for a centralized system for treatment was felt. Accordingly, in September 2003, the Central Pollution Control Board enunciated the "Guidelines for Common Bio-Medical Waste Treatment Facility" which in addition to providing common facilities discouraged the setup of individual incineration facilities by health care establishments (hospitals, clinics, laboratories etc).

3.5.4.1 Bio Medical Waste Categories as per BMW rules

According to the BMW Management Rules 2016, the waste is classified in to four categories. A brief description of different categories of BMW, type and colour coding of bags/container along with treatment and disposal are given in **Table 10.**

Table 10

Categories of Bio Medical Waste

Category	Type of Waste	Type of Bag/ Container	Treatment and Disposal options (as per BMW Rules, 2016)	Treatment / Disposal
Yellow	**(a)Human**	Yellow coloured non-chlorinated plastic bags	Incineration or Plasma Pyrolysis or deep burial	Incineration
	(b)Animal Anatomical Waste			Incineration
	(c)Soiled Waste		Incineration deep burial or Plasma Pyrolysis/ Autoclaving or micro-waving/ Treated waste to be sent for energy recovery.	Incineration
	(d)Expired/Discarded Medicines antibiotics, cytotoxic drugs including all items contaminated with cytotoxic drugs along with glass or plastic ampoules, vials	Yellow coloured non-chlorinated plastic bags	Expired cytotoxic drugs to be returned back to the manufacturer for incineration at temperature >1200^{0}C or to Common facility for incineration or Encapsulation or Plasma Pyrolysis.	Incineration
	(e)Chemical Waste Chemicals used in production of biological and used or discarded disinfectants.	Yellow coloured containers/ non-chlorinated plastic bags	Disposed of by incineration/or Plasma Pyrolysis/ Encapsulation in hazardous waste treatment, storage and disposal facility.	Incineration
	(f)Chemical Liquid Waste: Liquid waste generated due to use of chemicals in production, Silver X-ray film developing	Separate collection system leading to effluent treatment system	After resource recovery, the chemical liquid waste shall be pre-treated before mixing with other wastewater. The combined discharge shall conform to the discharge norms	Not accepted at the CBWTF

Category	Type of Waste	Type of Bag/ Container	Treatment and Disposal options (as per BMW Rules, 2016)	Treatment / Disposal
	liquid, discarded Formalin, infected secretions			
	(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/Plasma Pyrolysis/ for energy recovery.	Incineration
	(h)Microbiology, Biotechnology and other clinical laboratory waste: Blood bags Lab cultures, stocks or specimens of micro-organisms, live or attenuated vaccines, human and animal cell cultures used in research, industrial laboratories, 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 Organisation or World Health Organisation guidelines thereafter for Incineration.	Incineration
Red	**Contaminated Waste (Recyclable)** Wastes generated from disposable items such as tubing, bottles, intravenous tubes and sets, catheters, urine bags, syringes (without needles	Red coloured non-chlorinated plastic bags or containers	Autoclaving/microwaving/hydroclaving followed by shredding or mutilation Treated waste to be sent to registered or authorized recyclers or for energy recovery	Autoclave
White (Translucent)	**Waste sharps including**	Puncture proof, Leak	Autoclaving/Dry Heat Sterilization followed by	Autoclave

Category	Type of Waste	Type of Bag/ Container	Treatment and Disposal options (as per BMW Rules, 2016)	Treatment / Disposal
	Metals: Needles, syringes with fixed needles, needles from needle tip cutter or burner, scalpels, blades, or any other contaminated sharp object that may cause puncture and cuts. This includes both used, discarded and Contaminated metal sharps	proof, tamper proof containers	shredding/mutilation/ encapsulation in metal container or cement concrete, combination of shredding cum autoclaving, and sent for final disposal to iron foundries or sanitary landfill or designated concrete waste sharp pit.	
Blue	**(a)Glassware**: Broken or discarded and contaminated glass including medicine vials and ampoules except those contaminated with cytotoxic wastes.	Cardboard boxes with blue coloured marking	Disinfection by soaking the washed glass waste after cleaning with detergent and Sodium Hypochlorite treatment/autoclaving/ microwaving and then sent for recycling.	Autoclave
	(b)Metallic Body Implants	Cardboard boxes with blue coloured marking		

3.5.4.2 Collection and Transportation

Collection and transportation shall be done in accordance with the BMW Management Rules 2016. In brief, BMW shall be collected from each healthcare establishment on a regular basis. It is the duty of the operator of common bio-medical waste treatment facilities (CBMWTF) to transport BMW from the premises of HCUs to any offsite CBMWTF. Only the vehicles complying as per the existing rules shall be to carry secured load, clearly marked with the name and address of the waste carrier and bio-hazard sign. BMW shall be transported through designated route, with colour coded, covered and leak proof trolleys to avoid spillage on road.

3.5.4.3 Bio Medical Waste Incineration

A common incinerator will be used for incineration of all incinerable hazardous and biomedical waste coming to the facility.

3.5.4.4 Autoclave

The primary purpose of autoclave is to sterilize/disinfect the waste with steam. MoEF&CC has stipulated a temperature of 120^{o}C with 15 psi pressure and 60 min duration to ensure distribution of temperature. At this temperature and pressure, microorganisms are completely destroyed and thus render the wastes infection free. The dis-infected waste shall then be segregated into HDPE, PP, rubber, latex, glass and metal. The segregated materials shall then be shredded completing the process of disinfection and ensuring non-recycling of the waste materials for medical / food grade purposes. All the process control conditions will be as per the applicable bio medical rules.

Autoclave Features

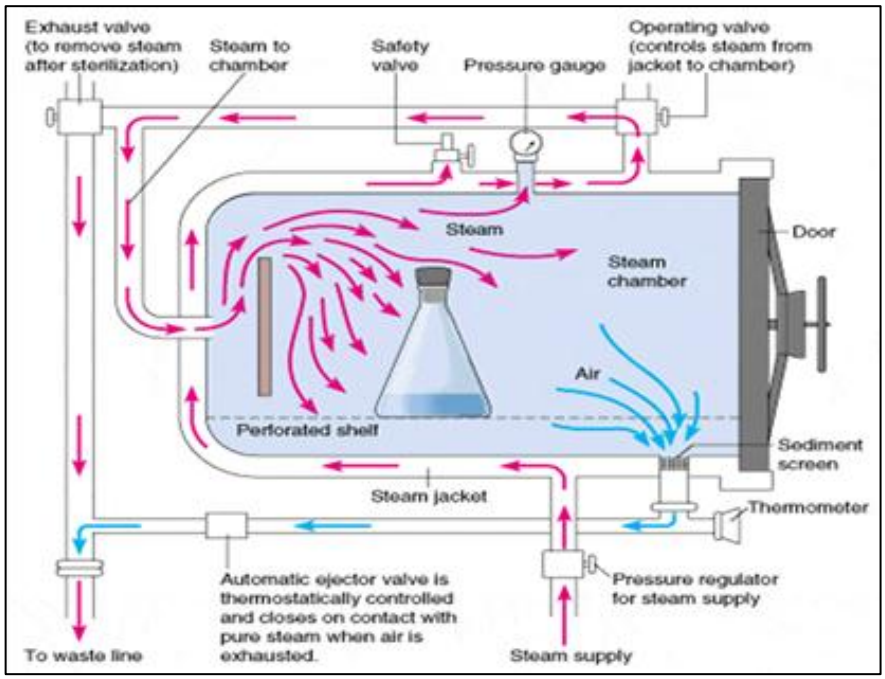
A vacuum type (programmable) autoclave which can operate at all the specifications mentioned by MoEF&CC with a capacity to handle 2 TPD is proposed. The autoclave shall have continuous and automatic recording of temperature, pressure, date, time and batch of loading. Every batch shall be monitored with a strip chart recorder and once in a month the spore validation test and/or spore monitoring shall be done. The key features of the proposed autoclave are given in **Table 11.** The schematic of typical autoclave sterilization process is given in **Figure 5.**

Table 11
Proposed Features of Autoclave

Type	Vacuum Type, automatic with documentation
Capacity	2 TPD
Temperature	121°C
Pressure	15 psi
Time	60 min
Automation	PLC with MMI (Man-Machine interface)
Documentation/ Recording	Computerized recording

Figure 5

Schematic of Autoclave Sterilization Process



3.5.4.5 Shredder

A mechanical shredder with a capacity of 150 Kg/hr to make the bio-medical waste unrecognizable shall be installed. The shredder shall be properly designed and covered to avoid spillage and dust generation. The hopper and cutting chamber of the shredder shall be designed to accommodate the waste bag full of bio-medical waste. The shredder blades are highly resistant and able to shred waste sharps, syringes, scalpels, glass vials, blades, plastics, catheters, broken ampoules, intravenous sets/ bottles, blood bags, gloves, bandages etc. The shredder blades shall be of non-corrosive and hardened steel.

The shredder shall be designed and mounted in such a way that it doesn't generate much noise and vibration. If hopper lid or door of collection box is opened, the shredder shall stop automatically providing safety to the operator. In case of shock-loading (non-shreddable material in the hopper), there shall be a mechanism to automatically stop the shredder to avoid any emergency/accident. In case of overload or jamming, the shredders shall have mechanism of reverse motion of shaft.

The shredder shall have low rotational speed (maximum 50 rpm) to ensure better gripping and cutting of bio-medical waste. The discharge height (from discharge point to ground level) shall be sufficient enough (minimum 3 feet) to accommodate the containers for collection of shredded material to avoid spillage.

3.5.5 Recycling Facilities

The recycling facilities proposed for the site are

- E-waste recycling facility
- Alternative fuel and raw material facility
- Waste plastic recycling
- Waste paper recycling
- Spent solvent recovery
- Waste Oil /Used Oil recovery
- Used lead acid battery recycling

3.5.5.1 E- waste recycling

The assessment of E-waste recycling sector in India indicates that E-waste trade starts from the formal dismantling sector and moves to informal recycling sector. There are no large scale organized E-waste recycling facilities in India at present except a few in some states of India. Hence, this will be an opportunity to serve the industries by handling their E-waste. The proposed project aims at recycling and disposal of WEEE waste with proper environmental compliance.

The facility will accept the following waste:

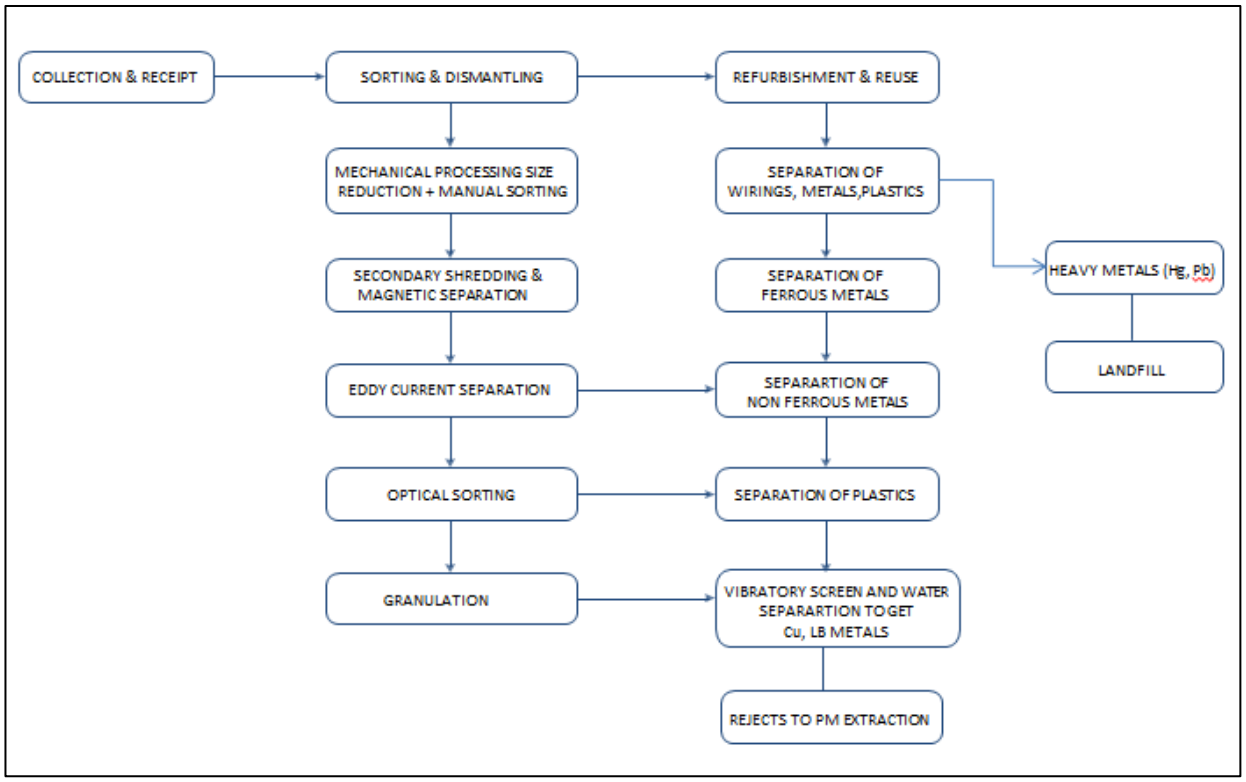
- Computer scrap containing main frame computers, personal computers, keyboards, monitors without the glass tube, printers, faxes, etc.
- Home appliances containing videos, TV sets without the glass tube, record players, CD players, hair dryers, toasters, vacuum cleaners, radios, coffee makers, micro wave ovens, etc.
- Handheld tools like drilling machines, grinding machines, etc. Small electric motors.
- Aluminum material containing cast items, extrusions, profiles, sheets, window frames, etc.
- Electric scrap containing contactors, relays, main breakers, fuses, contact bars, switches, instruments, etc.
- Electronic and telegraphic scrap containing electro mechanical switchboards/relays, computerized switchboards, printed circuit boards, etc.

Process Description

Upon client's request, project management shall arrange a suitable and secured transport to collect the material from his premises. The collection and transportation of E-waste shall be carried out as per the manifest system whereby the transporter shall be required to carry a document (four copies) prepared by the sender as per Form-6, EWM Rules 2016. The process involved in the proposed integrated E-waste management facility is basically physical destruction and shredding to downsize. The steps of proposed process are described in following paragraphs and the process flow sheet is given in **Figure 6**.

Figure 6

Proposed Flow Chart for E Waste processing



- When the E-waste items arrive at the recycling plant, the first step involves sorting all the items manually. After hand sorting, the next step involves a labour-intensive process of manual dismantling. The E-waste items are taken apart to retrieve all the parts and then categorized into core materials and components. The dismantled items are then separated into various categories into parts that can be re-used or continue the recycling processes.
- After sorting and dismantling, some of the components are subjected for refurbishment and reuse.
- Items that cannot be dismantled efficiently are shredded together with the other dismantled parts to pieces less than 2 inches in diameter. It is done in preparation for further categorization of the finer E-waste pieces.
- The finer E-waste particles are evenly spread out through an automated shaking process on a conveyor belt which are broken down further. At this stage, dust is extracted and discarded in a way that it does not degrade the environment.
- An over-band magnet is used to remove all the magnetic materials including steel and iron from the E-waste debris.
- The sixth step is the separation of metals and non-metallic components. Copper, aluminum, and brass are separated from the debris to only leave behind non-metallic materials. The metals are either sold as raw materials or re-used for fresh manufacture.
- Air-based optical sorting technique is used to separate the light materials from the heavier ones.

- As the last step, plastic content is separated from glass by use of water. One separated, all the materials retrieved can then be resold as raw materials for re-use. The products sold include plastic, glass, copper, iron, steel, shredded circuit boards and valuable metal mix.
- Heavy metals such as mercury and lead will be disposed in the landfill.

3.5.5.2 Alternative Fuel and Raw Material Facility

The ideal way of handling and disposal of hazardous waste is to look for options such as reuse, recycle/recovery. In line with this concept, AFRF is meant to pre-process the waste at TSDF to make it directly suitable to utilize in cement kilns either as raw material or fuel. In view of the potential for reuse of hazardous waste, the proposed project envisages to set up an AFRF in its proposal.

Process description

The first step is pre-processing of waste. The waste suitable for co-processing shall be directed to AFR facility for pre-processing like blending / mixing / calorific value enriching etc., which will homogenize the wastes received from different industries and bring the pre-processed waste characteristics in line with concentration limits as prescribed by CPCB. There are three types of wastes that are to be processed:

i. Solid Wastes

- The potential solid wastes that can be converted as alternate fuels suitable for co-processing in cement plants are taken into a mixer / blender. A solid blend is prepared by adding some additives to adjust all relevant parameters.
- The segregation of waste according to their pH and calorific value helps in the preparation of solid blend. Source materials for solid substitute fuels include paint sludge, oily filter cake, spent carbon, organic waste, tarry waste, biomass, resin, distillation residues, grease etc. A general waste selection criterion for high calorific value fuel is- Low moisture content, high LOI and TOC, high calorific value, good compressibility, less ash content, non-toxic, less polluting, sustain combustion etc.
- After selection, the waste is mixed with binders. Some common binders which can be used for blending are rice husk, press mud, bagasse, saw dust, scrape of coconut, coal dust, lime, silicates, epoxy resins, fly ash etc. Binders should have properties such as easily available, cost-effective, produce strong final agglomerates, permanently bond particles, withstand the rigors of storage, handling, packaging and shipping.
- The addition of strength increasing additives such as latex, pulp from the pulp and paper industries, paper, cardboard, acrylic copolymers, starch, starch derivatives, vinyl derivatives, cellulose, cellulose derivatives, peat moss etc. plasticizers to improve the adherence and plasticity; inorganic components like bentonite or other types of clay, and cement are optional components to provide different

characteristics to the blended product. Final pre-processed waste mix may contain 90% of waste and 10% binders.

Methodology

- In general incinerable wastes are received in drums, containers and occasionally in bags or bulk. A cart dumper shall be used for loading of the waste into the blender which is placed at elevated location. Typically mechanical mixer or a solid material blender shall be used for mixing / blending the waste. The outlet of the blender shall be opened into a container placed below the blender.
- The laboratory advises the type of wastes that can be mixed and / or various reagents / additives that are required to be added to make final blend to get the prescribed standards for co-processing in cement plants.
- Samples shall be taken after the blending process and subjected for confirmation from the lab as per acceptability criteria otherwise the process will be continued to fine tune to get the whole matrix reaches to the acceptable criteria. Then the waste will be unloaded, packed and sent to cement plants.

ii. Liquid Wastes

In general liquid wastes are received in drums or tankers. The wastes after necessary pre quality check will be stored in the day tanks as per their compatibility. The suitable and compatible wastes are taken into a reaction vessel (typically 5 KL capacity) which is equipped with necessary blending arrangements for mixing and homogenization of various reagents and wastes. Fine tuning will be done for achieving necessary characteristics as desired, for the co-processing requirements for cement plants.

iii. Semisolid / Tarry Wastes

Certain wastes are neither liquids nor solids but they are in semisolid state called as sludge. Based on the viscosity of the waste, we can categorize them as free flowing sludge, heavy sludge etc. In addition certain wastes are tarry or sticky in nature and sometimes it is difficult to remove from the drum.

Semisolid wastes are handled in two ways depending on the physical characteristics and viscosity.

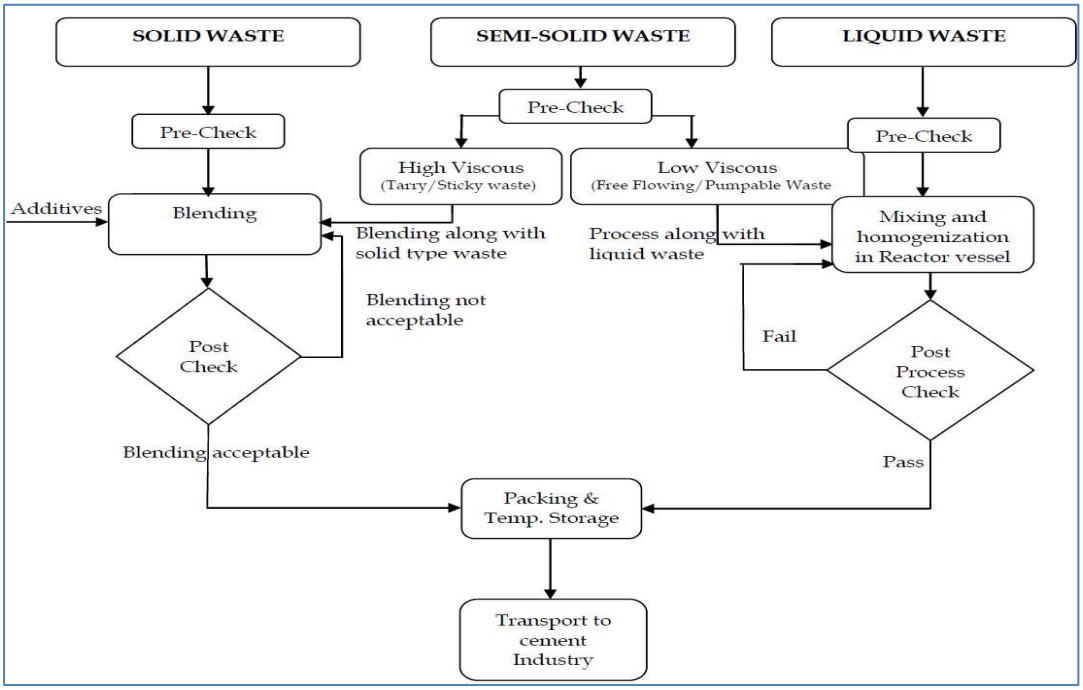
a. The wastes which are free flowing or pump able in nature are processed as per liquid type wastes

b. The wastes which are heavy sludge, sticky/tarry type wastes are processed as per solid type wastes.

A flow chart showing the processes involved for all three types of wastes suitable for co-processing is given below in **Figure 7**.

Figure 7

Flow chart showing co-processing for all three types of wastes

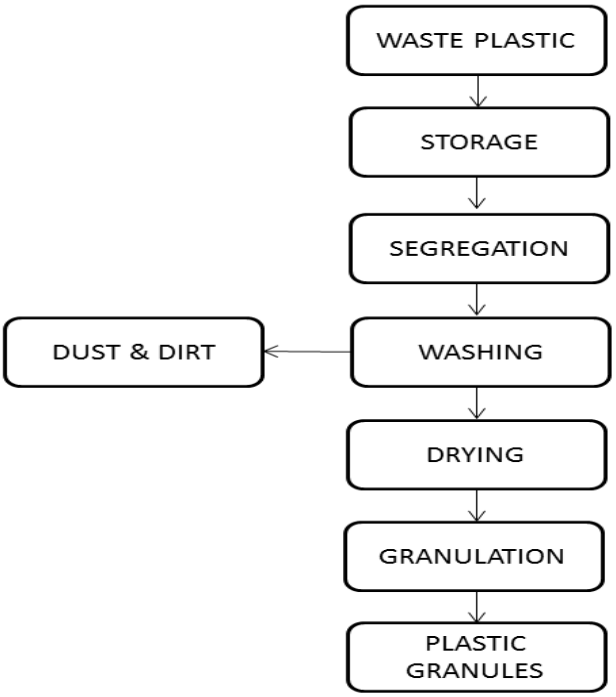


3.5.5.3 Waste Plastic Recycling

A plastic recycling plant uses seven steps to turn plastic trash into recycled plastic. The process flow sheet of waste plastic recycling is given in **Figure 8.** Following is a brief explanation of recycling:

Figure 8

Process flow sheet of plastic recycling



- **Segregation:** The plastic shall be segregated manually into two major components i.e. dirty plastic not suitable for granulation and plastic that can be used for granulation.
- **Mechanized cleaning:** Mechanized cleaning is done with some cleaning agents to remove any types of hazardous substances in the drum. The cleaned drums can be re-used or further processing can be done based on the requirement.
- **Chopping:** The washed drums are chopped into flakes for further processing.
- **Drying:** The plastic flakes are dried in a tumble dryer.
- **Melting:** The dried flakes are fed into an extruder, where heat and pressure melt the plastic. Different types of plastics melt at different temperatures.
- **Filtering:** The molten plastic is forced through a fine screen to remove any contaminants that slipped through the washing process. The molten plastic is then formed into strands
- **Pelletizing:** The strands are cooled in water and chopped into uniform pellets. Manufacturing companies buy them from recyclers to make new products.

3.5.5.4 Waste Paper Recycling

Waste paper recycling is the process of recovering waste paper and remaking it into new paper products. There are three categories of paper that can be used as feedstock for making recycled paper:

- **Mill broke**: Paper trimmings and other paper scrap from the manufacture of paper, and is recycled internally in a paper mill.
- **Pre-consumer waste**: Material which left the paper mill but discarded before it was ready for consumer use.
- **Post-consumer waste**: Post-consumer waste are the material discarded after consumer use such as old magazines, old newspaper, office wastes, old telephone directories, residential mixed paper, industrial packaging, waste multi-wall cement paper bags.

Processing of waste paper for recycling

ICWF focuses on recovering waste paper and sending to paper manufacturing industry. It is proposed to carryout waste paper processing in the following steps:

- **Waste Paper Collection:** Collection of waste paper material shall be done through special color coded recycling bins (segregated directly at Generator's premises). However, at some locations all kinds of papers may be collected in a single bin.
- **Manual Segregation**: The waste paper (newspaper, office stationary, packaging paper, card boards) collected is segregated according to variety/thickness of paper.
- **Compaction and Baling**: The waste paper is manually fed to the Baling press. It is Equipment which utilizes Hydraulic pressure on the loose paper in an enclosed chamber to compact them into Bales. The bale weight can be varied from 40–60 kg, making them very convenient to handle manually.

- **Transportation**: Transportation of bales to paper mills and other paper related product manufacturing units. The schematic of waste paper recycling is given in **Figure 9**.

Figure 9

Schematic of Wastepaper Recycling

Baling Wire and Tape

3.5.5.5 Spent solvent recycling

Spent solvents are recovered using a distillation methodology. A few solvents proposed to be separated /distilled initially are:

- Isopropyl alcohol
- Butanol
- Dimethyl formamide
- Toluene and
- Ortho dichlorobenzene.

Storage of spent solvents

- The waste solvents shall be received in drums (MS/Plastic) and stored in sheds which will be provided with garland drains, fire hydrant system, lined flooring etc.
- The drums shall be stacked as per the best practices. The leakages shall be avoided at any point of time.
- A separate storage shed is proposed adjacent to the facility to store the drums.
- The stacking of drums shall be in such a manner that mixing of solvent drums shall be avoided to a maximum extent.

Recovery of spent solvents

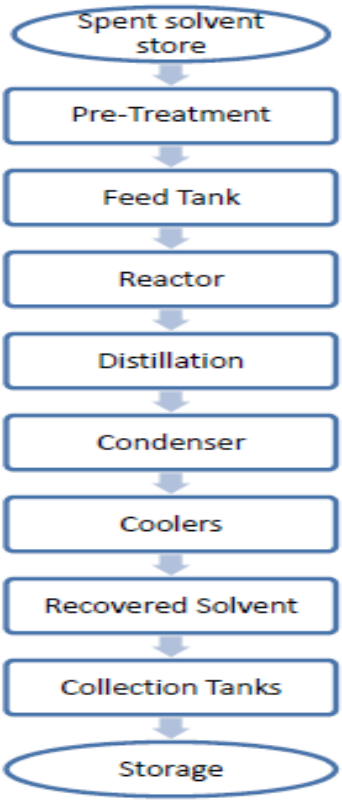
Distillation process is the most suitable for the recovery of most of the spent solvents which can be either a batch or continuous operation. However, it is proposed to adopt batch process in the proposed facility.

Process description

The process involves pre-treatment, followed by neutralization and separation of spent solvent feed mixture in a reactor. After layer separation, the spent solvent mixture will be sent to distillation connected to distillation column. The solvent mixture is heated by

steam and the distillation column will be under total reflux for a specific period. Fractionation of solvent takes place and solvent / water as the case may be are separated initially under atmospheric pressure and later under vacuum. Distilled solvents are analyzed, stored and recycled, liquid effluent which is mostly condensate will be recycled back into system and solid residue sent for incineration / landfill. Steam for heating will be donor from the boiler. Flow chart for Spent Solvent recovery is shown in **Figure 10.**

Figure 10
Flow Chart of Spent Solvent Recovery



3.5.5.6 Used oil/Waste oil recovery

Used oil is termed as hazardous. Lube oil does not wear out with use it only gets contaminated with water, carbon and fuel etc. that means used oil when it is ready for rejection can be re-used. The methods of disposal being followed are dumping, burning or reprocessing. The used/waste oil generated is not easily biologically degradable. Burning is not desirable for the following reasons:

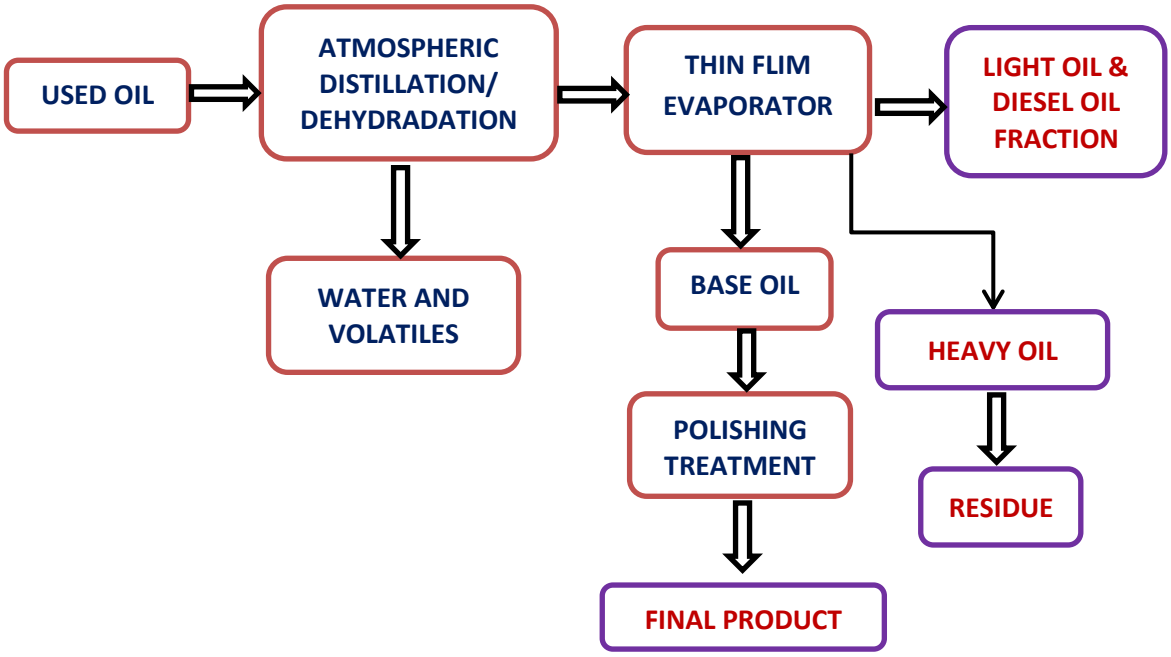
- Waste fuel oil contains substantial quantity of water that will prevent proper burning of fuel and lead to generation of carbon monoxide.
- The used oil (used lubricants, Transformer oils etc), may contain chemicals, metallic compounds, Polychlorinated Biphenyl (PCBs) etc which when burned will release gas to the atmosphere.

- Other option is repressing. But improper reprocessing methods can lead to generation of waste which is even more hazardous than used / waste Oil.
- Therefore, reprocessing should be allowed only with approved methods. Reprocessing is not only a solution for disposal of waste but it will have tremendous economic advantage.

Process description

The proposed modular used oil recycling plant is a complete skid mounted facility ready for immediate installation. These proposed modular units are particularly advisable for small recycling capacities. They fulfill the requirement of environment friendly technology of short path thin evaporation as proposed by CPCB for granting consent to recyclers, re-refiners of used oil. Agitated thin film evaporator, through the short path distillation unit is used to separate the heavy base oil without fouling of the process equipment with coke. The residue obtained after the fractionation is a brown carbon-free viscous oil that can be sold as a lubricant for the heavier applications such as heavy gear lubricant/sugar mill compounds/open gear lubricant or any other application where a heavy viscous lubricant would be required. Used oils are separated by a simple procedure of settling followed by dehydration, thin film evaporation and short path distillation. The fractioned base oils obtained from this process would be treated with activated clay to yield light colored base oil fit for re-use in lubricating oils. The proposed system is designed to obtain high quality base oil. The schematic of waste/ used oil recycling is shown in **Figure 11.**

Figure 11
Treatment scheme for waste/used oil recycling



3.5.5.7 Used lead acid battery recycling

Lead is one of the most vital nonferrous metal having multiple uses like in lead acid batteries, cable covering, alloying elements in solders, nuclear shield etc. In terms of its chemical composition, it is used in glass, paint and as an important stabilizer in PVC as lead striate. Almost 70 to 80 % of lead production comes from recycling and the balance 20 to 30% from virgin sources that is lead concentrates. Demand for lead acid batteries is going up almost at the rate of 20 to 25% in India and China. The requirement of lead is also increasing alarmingly at the rate of 15 to 20 % annually. Almost 70% of the lead goes in to the production of lead acid batteries. In India, only Hindustan Zinc Limited and two other producers in smaller quantities produce lead from lead concentrates. Rest of the lead production is either from recycling or imports. Since more and more scrap of lead acid batteries and other scrap of lead will be available, there is a good scope to recover lead in and environmentally friendly manner.

Recycling of used lead acid batteries

- Extraction of lead from used lead acid battery plates, lead scrap, lead dross and other lead bearing wastes is carried out by using Rotary Furnace and Reverberatory Furnace.
- Conventional method of lead extraction from used lead acid battery plates, lead scrap, lead dross and other concentrate generates huge amount of sludge which becomes very difficult for disposal in the landfill. However, the combination of Rotary furnace and Reverberatory furnace with high calorific furnace oil as fuel reduces the quantum of slag generation and improves the recovery of lead metal considerably. Furnace oil will be used as fuel to melt the battery and other scrap. The schematic diagram of the lead recycling is shown in **Figure 12.**

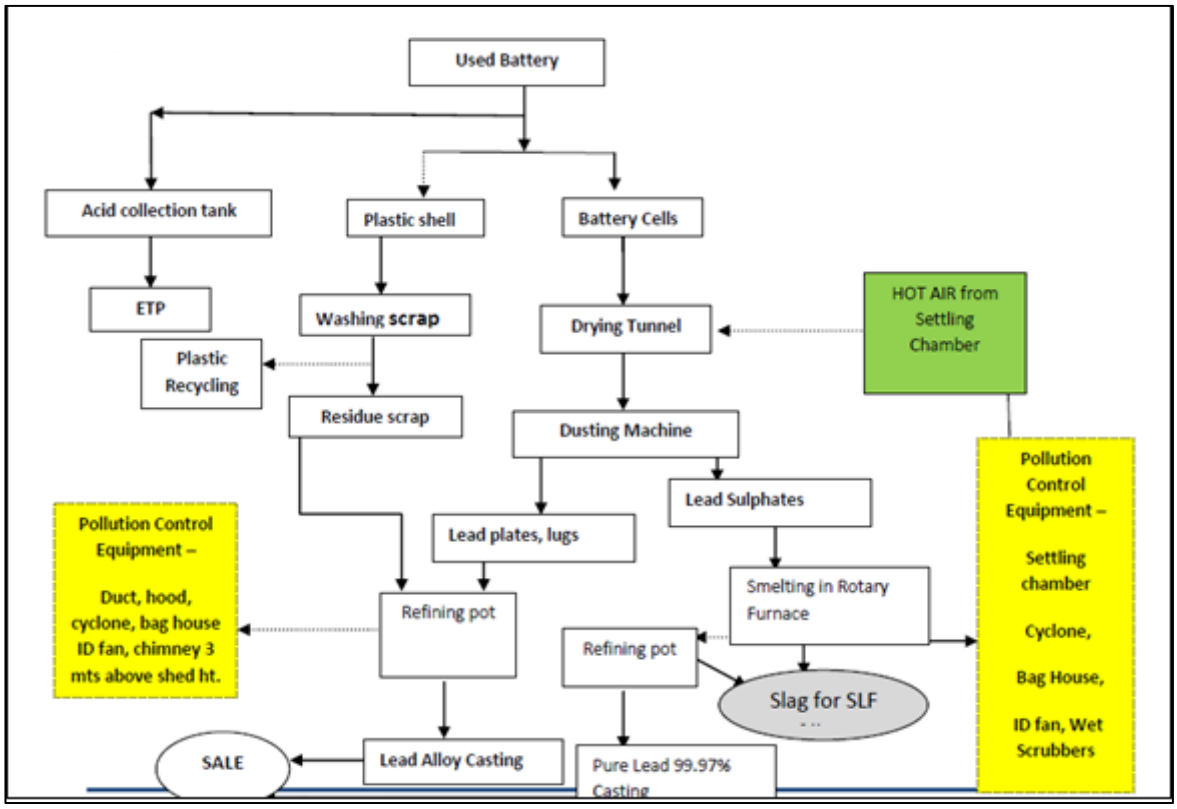
Process description for lead recycling

The smelting process proposed in lead recycling unit is explained briefly below:

- The raw materials namely, the batteries are received at the unit. The battery casing is broken with the help of cutting machine and sorted accordingly.
- The plastic containers, polypropylene wastes are processed in plastic grinding machine and the PVC separator waste is sold to the PVC recyclers.
- Initially, the lead scrap is fed into the rotary furnace and flux agents like charcoal, iron boring are added for ignition.
- The burner supplies the required heat for melting of scrap. After a sustained fire is established, the lead in the scrap (raw material) is melted gradually.
- The charging of charcoal and raw material are repeated and the molten metal is collected in a pot at the downstream side of the furnace.

Figure 12

Schematic diagram of the lead recycling from used lead acid battery



3.6 Raw Material Required along with Estimated Quantity, likely Source, Marketing Area of Final Products, Mode of Transport of Raw Material and Finished Product.

The proposed project is ICHWTSDF meant for treatment, storage and disposal of various types of wastes generated from various sources. Hence there are no major raw materials required for the proposed activities. However, small quantities of chemicals such as cement, lime, fly ash, bentonite clay, saw dust and others required for waste stabilization will be procured form local market as per the requirement and stored in the stores room.

3.7 Resource Optimization/Recycling and Reuse Envisaged in the Project, if any, should be briefly outlined.

The proposed facilities are mainly based on the concept of material recovery and reuse of waste collected from various sources. The recyclable materials such as paper, plastic, E-waste, lead from used lead acid batteries, etc. will be sold to the authorized agencies for further use.

3.8 Availability of Water its Source, Energy/Power Requirement and Source should be given

The source of water for the proposed project is Pennaiyar River/ borewells/ tankers. The detailed breakup of water required for various activities and wastewater generation is

given in **Table 12.** The power required for the project will be sourced from Samalpatti power corporation/TNEB. The details of power requirement are given in **Table 13.**

Table 12

Water requirement and wastewater generation details

Description	**Water requirement (KLD)**				**Remarks**
	Fresh	**Treated**	**Total**	**Effluent**	
Direct landfill	-	2	2	1	Treated in LTP and reused for spraying on landfill or disposed through incinerator (spray dryer)
Landfill after treatment	-	16	16		
AFRF facility	-	-	-	-	Sent to ETP for treatment and re-use (floor washing, wheel washing, incinerator make-up water)
Biomedical waste treatment facility	1	-	1	-	
Incinerator (common for Hazardous & BMW)	48	22	70	30	
E- waste recycling facility	1	0	1	0.5	
Paper recycling facility	0	0	0	0	
Plastic recycling facility	1	0	1	0.5	
Waste/used oil recovery facility					
Solvent recovery facility	36	0	36	10	
ULAB recycling facility	3	0	3	0	
Floor Washing, wheel wash	0	5	5	4	
Sub total	**90**	**45**	**135**	**46**	
Domestic (consumption, wash rooms, maintenance etc.)	5	0	5	4	Sent to soak pit/ treated in STP
Greenbelt	30	0	30	0	
Total	**125**	**45**	**170**	**50**	
Note: Leachate generation during rainy period = 30 cu. m/day					

Leachate estimation (Source: Swacch Bharath Mission Manual**)**

Average total precipitation (IMD, Dharmapuri district) = 900 mm/Yr

Land area of operating phase of landfill = 5000 Sq.mt

Assuming 80% precipitation in four months (monsoon period) = 720 mm/4 months

Peak leachate quantity = (0.72 X 5000/120)= 30 cu.m/day

Table 13

Power Requirement Details

Details	**kVA**	**Remarks**
Power required	1500	Sourced from Samalpatti power corporation/TNEB
DG set	1x 200 kVA 1x300 kVA	Used only for emergency power backup
HSD Fuel for DG set/Incinerator	60 Lts/hr	Purchased from local dealers

3.9 Quantity of Wastes to be Generated (Liquid and Solid) and Scheme for their Management/Disposal.

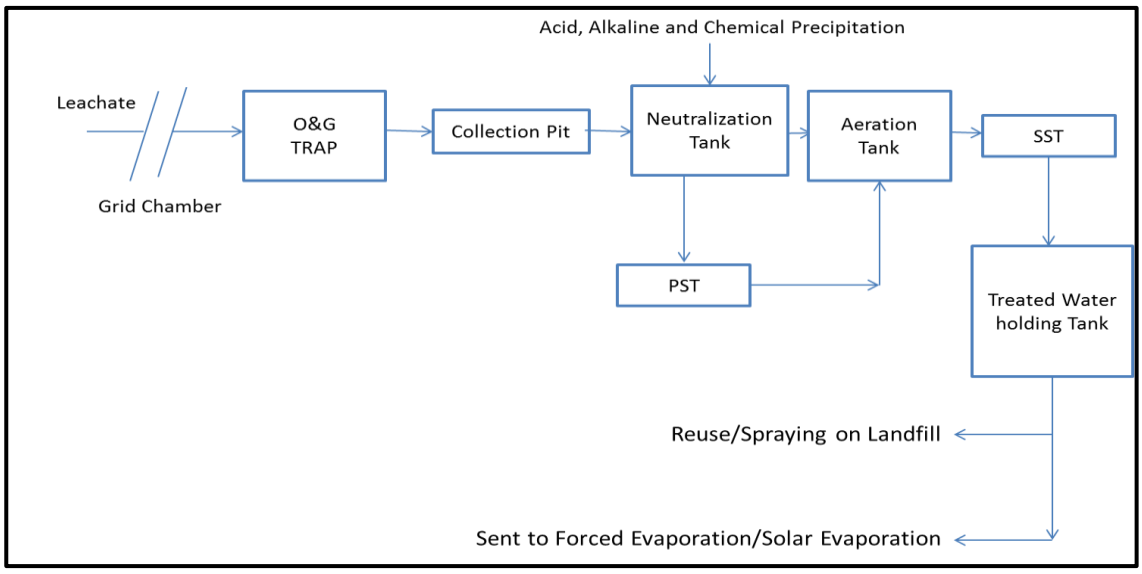
Liquid waste

Leachate Collection/ Treatment and Disposal

The collected leachate will be sent to grid chamber thereafter sent to Oil & Gas trap, from where it will be further conveyed to collection pit. The leachate is then treated with acid/alkali/chemical precipitation in the neutralization tank. After treatment, it will be further sent to primary settling tank and then to aeration chamber. The leachate will be further sent to secondary settling tank and finally to treated water holding tank. Treated leachate will be finally reused as sprayer on the landfill or sent for forced evaporation/Solar evaporation. The schematic diagram of Leachate Treatment Plant (LTP) is given in **Figure 13**.

Figure 13

Schematic diagram of Leachate Treatment Plant



Wastewater/ Effluent Treatment Plant

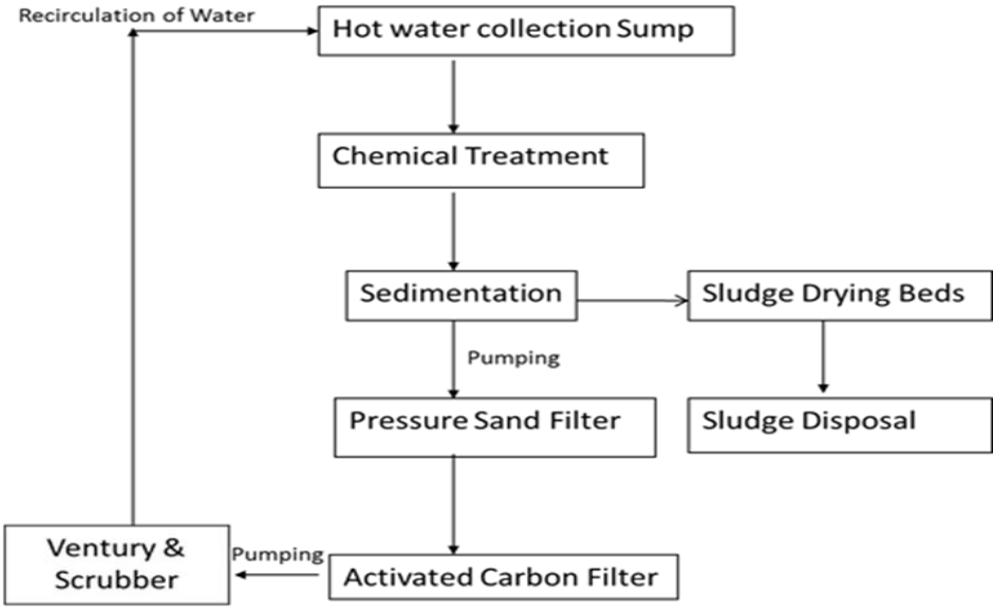
The wastewater generated from scrubbing, floor washing and other facilities will be treated in WWTP before it is recycled back to the process. The treated water shall be reused for circulation into the scrubber. Briefly, the treatment system consists of cooling tank, pressure sand filter and activated carbon filter assembly followed by neutralization before recirculation into the scrubber. Schematic of the proposed WWTP is given in **Figure 14.**

Domestic wastewater

The domestic wastewater will be collected separately and sent to septic tank followed by soak pit or treated in STP. On the whole, a zero liquid discharge system will be followed.

Figure 14

Schematic of the proposed WWTP



Solid waste

The proposed project is an ICHWTSDF with treatment, storage and disposal of various wastes. In the proposed project, the solid waste generated is incineration ash which would be generated from incineration of hazardous and biomedical waste. The details of solid waste generated and disposal methods are proposed is given in **Table 14.**

Table 14

Details of Solid Waste Generated

S.No	Description	Quantity	Remarks
1	Ash from incinerator (Hazardous waste)	13 TPD	Sent to Landfill
2	Ash from incinerator (BMW)	25 kg/day	
3	Sludge from AFRF	500 kg/day	Sent to incinerator
4	Sludge from Waste/used oil	500 kg/day	
5	Solvent sludge	250 kg/day	
6	Waste oil from DG set	100 lts/year	
7	Municipal solid waste	21 kg/day	Nearest municipal bin

3.10 Schematic Representation of the Feasibility Drawing for EIA Purpose

For the development of proposed project, site screening, pre-feasibility report, environmental impact assessment (EIA) and environmental management plan (EMP) studies, etc. are required for obtaining environmental clearance and consent for establishment from statutory authorities.

- Submission of Form-1, Prefeasibility report, draft ToR for appraisal to the concerned authority (MoEF&CC)
- Obtaining official Terms of Reference from MoEF&CC
- Base data collection for one season, EIA report preparation compliance with ToR
- Obtaining EC from MoEF&CC
- Submission of CFE application to SPCB
- Obtaining CFE from SPCB

4 Site Analysis

4.1 Connectivity

The site is well connected to all the nearby places with road developed by SIPCOT. National Highway NH-77 Krishnagiri to Tindivanam is located 5.4 km NE from the site. State Highway SH-60 Hogenakkal to Tirupattur is located 6.1 km W from the site. Pokkampatti village is located 0.7 km NNW. The nearest town is Pochampalli 5.1 km, W. The nearest railway station is Dasampatti railway station at a distance of approx. 6.9 km SE. The nearest airport is Salem airport 68 km SW.

4.2 Land form, Land Use and Land Ownership

State Industries Promotion Corporation of Tamil Nadu Limited (a Government of Tamilnadu Undertaking) has allotted the land to Industrial Waste Management Association for establishment of ICHWTSDF at SIPCOT industrial complex, Bargur and given in principal approval for obtaining Environmental Clearance from MoEF&CC, New Delhi.

4.3 Topography (Along with Map)

Krishnagiri district forms part of the upland plateau region with many hill ranges and undulating plains. The western part of the district has hill ranges of Mysore plateau with a chain of undulating hills and deep valleys extending in NNE-SSW direction. The topographical map of the study area (5 Km) is shown in **Figure 15.**

4.4 Existing Land Use Pattern (agriculture, non-agriculture, forest, water bodies (including area under CRZ)), shortest distances from the periphery of the project to periphery of the forests, national park, wildlife sanctuary, eco sensitive areas, water bodies (distance from the HFL of the river), CRZ. In case of notified industrial area, a copy of the gazette notification should be given.

The proposed facility is located within the SIPCOT industrial complex. The distance between the project site and some eco-sensitive areas are given below:

- Senrayaswami Hill Forest is located at 1.2 km (SE),
- Kallavi Reserve Forest at 9.4 Km (SE),
- Penukondaapuram Lake is located 5.3 km (N),
- Pennaiyar River is located at 9.45 km (SW)

Figure 16 shows the Eco-sensitive areas near the proposed site. The land approval document issued by SIPCOT to TNWML (Lr. No. SP/HWTSDF/2018 dated 29.01.2018) is attached as **Annexure 2.**

Figure 15

Topo map showing 5 Km of the study area

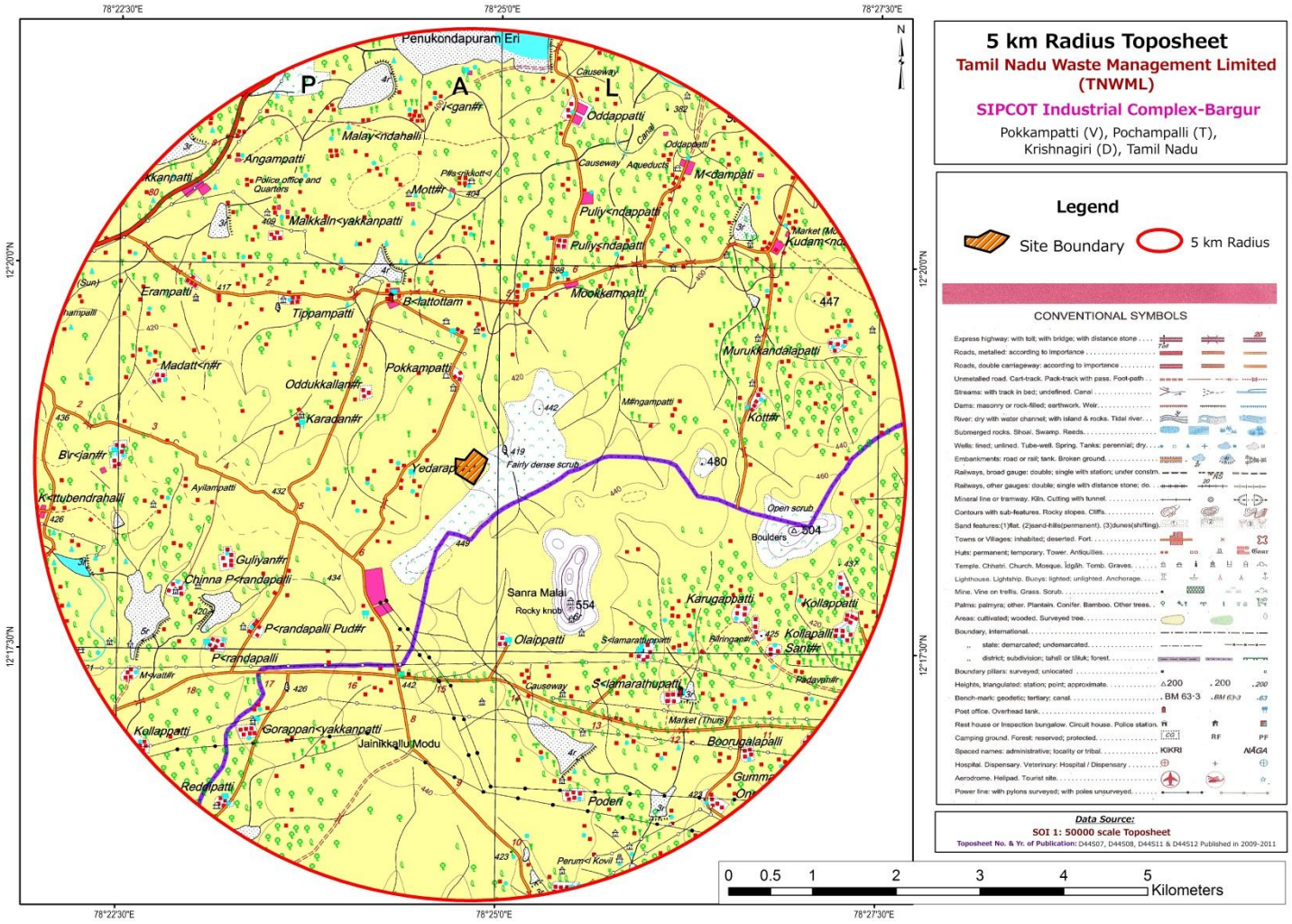
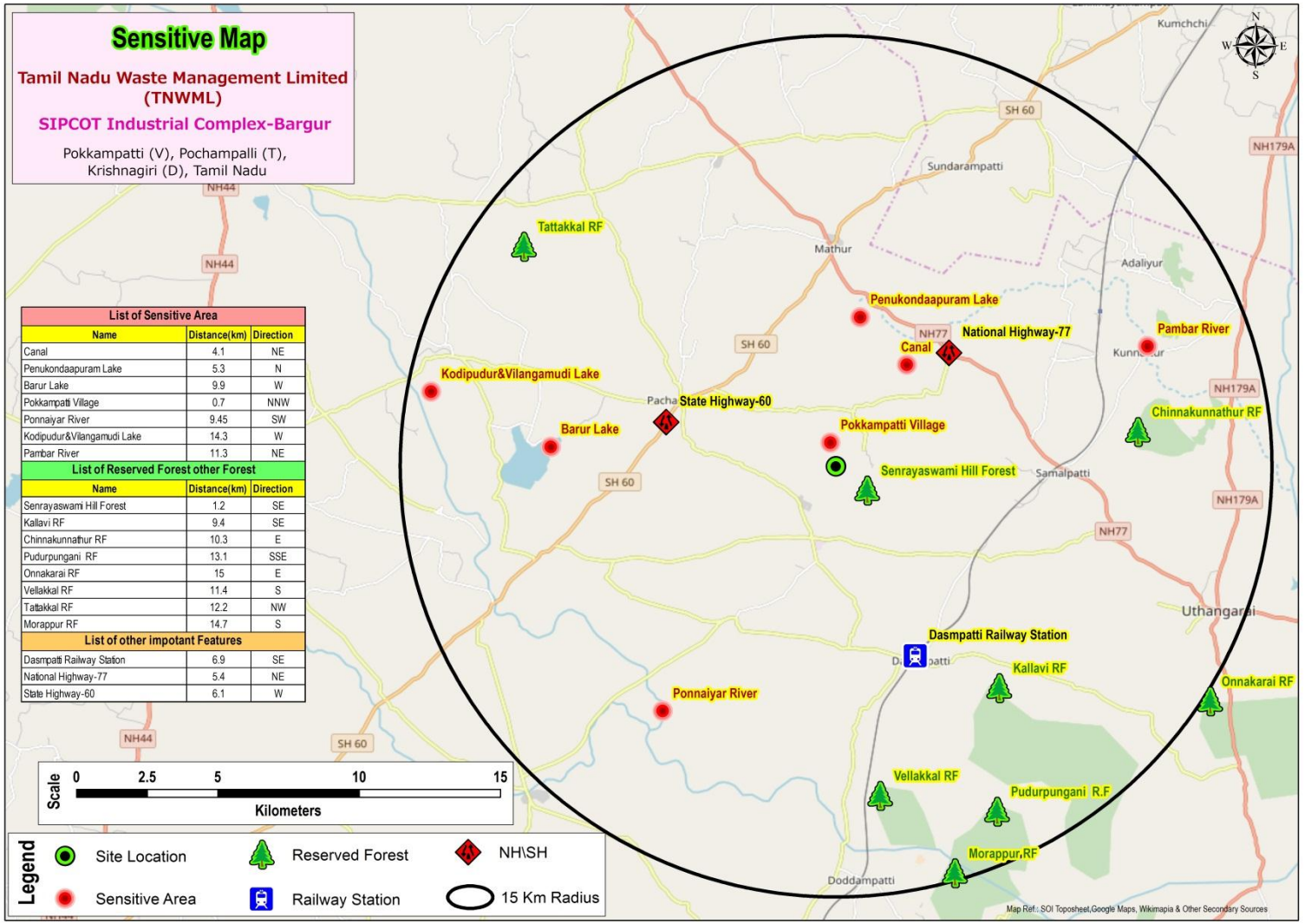


Figure 16

Eco-sensitive areas near the proposed site



4.5 Existing Infrastructure

There is no existing infrastructure in the land allocated for proposed project. Required infrastructure like roads, industrial sheds, buildings, drainage, storm water drains etc will be developed.

4.6 Soil Classification

Data on soil is acquired from Central Ground Water Book (CGWB), Krishnagiri district, Tamil Nadu. Soils of the district have been classified into black, mixed, red loamy, gravelly and sandy. In general, the soil in the district is quite loose and fresh with its colour from red to dark brown. The soil type varies between different taluks. The district is more suitable for cultivation of horticulture crops. The irrigation sources of the district indicate that wells are the major source of irrigation supplemented by tanks and canals. The major irrigated crops in the district are paddy, ragi, turmeric, sugarcane, banana, tomato, groundnut, cotton, coconut and flowers. This district has a great potential for agribusiness and export of agricultural products. It is said that the establishment of industrial complexes and special economic zones (SEZs) will further contribute to the development of the district.

4.7 Climatic Data from Secondary Sources

The climatological data for the proposed project is acquired from secondary source (IMD, Dharmapuri) which is presented in **Table 15.**

Table 15

Meteorological Data

Nearest IMD Station is Dharmapuri, 30 Km SW from the site										
Month	**Temperature °C**				**Humidity %**		**Rainfall**		**Mean Wind speed (m/s)**	**predominant wind direction**
	Mean Min	**Mean Max**	**Lowest**	**Highest**	**Min**	**Max**	**Monthly mm**	**No of rainy days**		**1st**
Jan	17.7	29.5	13.9	32.3	50	78	5.0	0.5	1.6	NE
Feb	18.7	32.7	14.7	35.5	39	71	3.8	0.3	1.5	NE
Mar	20.8	35.6	16.7	38.1	32	65	22.5	1.3	1.4	NE
Apr	23.8	37.0	20.4	39.4	38	65	44.2	2.5	1.3	SW
May	24.4	36.6	21.2	39.6	46	64	96.7	6.0	1.6	SW
Jun	23.8	34.2	21.6	37.4	51	65	70.0	3.8	2.2	SW
Jul	23.4	33.3	21.5	36.7	54	67	75.6	4.8	2.1	SW
Aug	23.0	32.6	21.1	35.8	55	69	105.5	6.0	2.0	SW
Sep	22.6	32.4	20.6	35.1	60	73	170.5	8.0	1.4	SW
Oct	21.8	30.8	19.4	33.3	68	78	181.5	9.3	1.2	NE
Nov	20.1	29.0	16.0	31.6	67	79	93.8	5.9	1.3	NE
Dec	18.3	28.0	14.2	30.6	60	80	41.5	2.8	1.5	NE
Source: GOI, Ministry of Earth Sciences, IMD, Climatological Tables 1981-2010										

4.8 Social Infrastructure Available

Social infrastructure facilities like Hospitals, Schools, Colleges, Banks etc., are available in the nearby villages. Pochampalli (5.1 Km, W) and Samalpatti (7.1 Km, E) are the major developed and nearby urban areas having all required social infrastructure.

5 Planning Brief

5.1 Planning Concept (Type of Industries, Facilities, transportation, etc.) Town and Country Planning/ Development Authority Classification

The proposed project is meant for treatment, storage and disposal of various wastes generated from industries, HCUs, commercial establishments, etc. The project is going to be established within the SIPCOT industrial complex, Bargur. Following are the type of industries existing in and around Bargur, krishnagiri district:

- Chemical, fertilizers, asbestos, granite industries.
- Production of iron and steel including other ferrous alloys, steel rolling etc
- Power plants, cement units
- Electrical, electronic and automobile industries
- Production /formulation of drugs/pharmaceuticals.
- Agro based, food processing and horticulture industries
- Electroplating, lead acid batteries recycling units, etc. Production, use and formulation of pesticides including stock-piles

5.2 Population Projection

There will be an influx of about 100 people to the area due to the proposed project and majority of them will be hired from the nearby villages.

5.3 Land Use Planning (Breakup along with Greenbelt etc.).

The total area allocated for proposed recycling facilities is around 10.11 Ha (25 Acres). The detailed land breakup of total area is given in **Table 16.**

Table 16
Land Breakup

Description	Area (Ha)	Area (Acres)	Area (%)	Remarks
Landfill	4.45	11.0	44.0	Greenbelt of 10 m will be developed along the boundary, 1m along the road (two sides), open areas, other than active landfills
Facilities	1.15	2.84	11.4	
Roads	1.15	2.84	11.3	
Green belt	3.33	8.25	33.0	
Parking	0.03	0.08	0.31	
Total	**10.11**	**25.0**	**100**	

5.4 Assessment of Infrastructure Demand (Physical & Social)

There will be a minimum influx of people to the area due to the proposed project, as the major manpower will be employed from the nearby villages. Hence the infrastructure available is sufficient to accommodate the demand.

5.5 Amenities/Facilities

All the amenities/facilities like security room, administrative building, R&D building, vehicle maintenance shed, weigh bridge, electrical utility area, toilet block, etc., are proposed for ICHWTSDF.

6. Proposed Infrastructure

6.1 Industrial Area (Processing Area)

The proposed project is to establish an ICHWTSDF within SIPCOT industrial complex, Bargur. All required infrastructure like sheds for treatment facilities, administration, stores, laboratory, roads, storm water drains, landfill, leachate treatment system, etc will be provided as per the requirement.

6.2 Residential area (Non-processing Area)

No residential area is proposed within the project site.

6.3 Greenbelt

A 10 m wide greenbelt will be developed all around the periphery of the project site. One row of plants along the road, in open areas and on completed cells of landfill so as to maintain 33% of the total area as greenbelt at any given time to meet MoEF&CC guidelines. The list of plants species for greenbelt development is given in **Table 17.**

Table 17

List of Plant Species for Greenbelt Development

S.No	Botanical Name	Family	English /common	S/T	Habit	Height
1	*Acacia auriculiformis A.cunn*	Mimoseae	Australian Wattle	T	Tree	16m
2	*Acacia polycantha Wild*	Mimoseae	cutch tree	T	Tree	10m
3	*Albizia odoratissima Benth*	Mimoseae	Black siris	T	Tree	18m
4	*Albizia procera Benth*	Mimoseae	White siris	T	Tree	20m
5	*Bambusa vulgaris Schrad*	Poaceae	The Golden Bamboo	T	Tall perennial grasses	15m
6	*Bougainvillea spectabilis Wild*	Bischofiaceae	Bougainvillea	T	Shrub	8m
7	*Cassia fistula Linn*	Caesalpinaceae	Golden showers	T	Tree	12m
8	*Cocos nucifera Linn*	Arecaceae	Coconut tree	T	Tree	10-15m
9	*Delonix regia (Boijer) Rafin.*	Caesalpinaceae	Flame tree	T	Tree	15m
10	*Dendrocalamus Strictus Nees*	Poaceae	Solid bamboo	T	Tall perennial grass	12m
11	*Derris Indica (Lann.) Bennett.*	Fabaceae	Pomgam- Oil tree	T	Tree	10m
12	*Eucalyptus citriodora Hook*	Myrtaceae	Lemon scented gum	T	Tree	20m
13	*Ficus benghalensis Linn*	Moraceae	Banyan tree	T	Tree	20m
14	*Ficus elastica Roxb*	Moraceae	Indian Rubber tree	T	Tree (Epiphytic)	12m
15	*Ficus religosa*	Moraceae	Peepal tree	T	Tree	20m
16	*Gardenia jasminoides Eills*	Rubiaceae	Cape jasmine	T	Tree	5m
17	*Ixora rosea*	Rubiaceae	Ixora	T	Tree	6m
18	*Lantana camara*	Verbenaceae	Lantana, Wildsage	T	Shrub	3m
19	*Moringa oleifera Lamk.*	Moringaceae	Horse Radish Tree	S	Tree	10m
20	*Nerium indicum*	Apocynaceae	Pink oleander	T	Shrub	5m
21	*Peltophorum pterocarpum*	Caesalpinaceae	Copper pod tree	T	Tree	-
22	*Phoenix sylvestris*	Arecaceae	The Wild datepalm	T	Tree	10m
23	*Polythia longifolia*	Anonaceae	Indian mast tree	S	Tree	15 or 5m
24	*Samanea saman*	Mmos eae.	Rain Tree	T	Tree	20m

S.No	Botanical Name	Family	English /common	S/T	Habit	Height
25	*Spathodea campanulata Beauv.*	Bignoniaceae	Indian Tulip tree	T	Tree	12m
26	*Syzygium cumini*	Myrtaceae	Black plum	T	Tree	20m
27	*Tabernaemontana divaricata*	Apocynaceae	Crape jasmine	T	Shrub	3m
28	*Tamarinduss indica*	Caesapinaceae	The Tamarind tree	T	Tree	20m
29	*Tecoma stans*	Bignoniaceae	Yellow bells	T	Shrub	5m
30	*Thevetia peruviana*	Apocynaceae	Yellow oleaner	T	Shrub	6m

Note: ***S/T= Sensitive/Tolerant (to air pollution)***

(Source: Guidelines for developments of green belts, CPCB, 2000)

6.4 Social Infrastructure

Social infrastructure facilities like Hospitals, Schools, Colleges, Banks etc., are available in the nearby villages. Pochampalli (5.1 Km, W) and Samalpatti (7.1 Km, E) are the major developed and nearby urban areas having all required social infrastructure.

6.5 Connectivity (Traffic and Transportation Road/Rail/Metro/Water ways etc.)

The site is well connected to all the nearby places with road developed by SIPCOT. National Highway NH-77 Krishnagiri to Tindivanam is located 5.4 km NE from the site. State Highway SH-60 Hogenakkal to Tirupattur is located 6.1 km W from the site. Pokkampatti village is located 0.7 km NNW. The nearest town is Pochampalli 5.1 km, W. The nearest railway station is Dasampatti railway station at a distance of approx. 6.9 km SE. The nearest airport is Salem airport 68 km SW.

6.6 Drinking Water Management (Source & Supply of Water)

The drinking water required for the proposed project will be sourced from South Pennaiyar River or procured from local market (tankers/water cans)

6.7 Sewerage System

The domestic wastewater generated from the proposed project will be sent to septic tank followed by soak pit. The wastewater from other activities along with leachate are collected separately and treated in Leachate /wastewater treatment plant and reused for dust suppression and spraying on landfill.

6.8 Industrial Waste Management

The proposed project is an ICHWTSDF having treatment, storage and disposal of various wastes as the major activities. In the proposed project, the solid waste is generated mainly from the incineration of hazardous waste. The industrial waste (fly ash) generated will be disposed in landfill and used as daily soil cover. Sludge generated from other activities like AFRF will be disposed into the incinerator.

6.9 Solid waste management

Domestic solid waste generated from the existing and proposed activities will be sent to the nearest municipal bin for further disposal.

6.10 Power requirement & supply/ source.

The power required for the existing and proposed expansion activities will be sourced from Samalpatti power corporation/TNEB. DG sets will be used for emergency power backup during power failure.

7 Rehabilitation and Resettlement (R&R) Plan

7.1 Policy to be adopted (Central/State) in respect of the project affected persons including home oustees and landless laborers (a brief outline to be given)

The proposed project is going to be established within the SIPCOT industrial complex, Bargur. Hence no rehabilitation and resettlement is envisaged.

8 Project Schedule & Cost Estimates

8.1 Likely date of start of construction and likely date of completion (Time schedule for the project should be given).

As per the initial estimate, around 6 months is required for implementation of the project considering the starting date i.e. from the date of receiving all the statutory clearances from concerned departments of state and central government.

8.2 Estimated project cost along with analysis in terms of economic viability of the project.

The capital cost for the proposed project is estimated to be around Rs 80 Crores. The capital cost allocated for EMP is around Rs 9 Crores with a recurring cost of Rs 1.50 Crores/annum.

After examining the environmental, commercial and financial feasibility of the proposed project and based on earlier experiences, it may be inferred that the project may have positive viability. The detailed cost breakup of the proposed expansion is given in **Table 18** and the detailed EMP budget is given in **Table 19.**

Table 18

Detailed Project cost breakup

S. No.	Project Name	Estimated Cost (Lakhs)
1	Direct landfill	3000
2	Landfill after Treatment	
3	Alternative Fuel & Raw Material facility	
4	Incinerator (common for Hazardous & BMW)	1000
5	Biomedical Waste Treatment Facility	1000
6	E- waste Recycling facility	500
7	Paper Recycling facility	250
8	Plastic Recycling facility	250
9	Waste oil / used oil recovery facility	300
10	Solvent recovery facility	100
11	Used lead acid battery recycling facility	100
12	EMP budget	900
13	Miscellaneous	100
14	Land Area	500
Total Amount		**8000**
Note: The above cost includes capital cost of EMP Rs. 9.0 Crores. CSR budget allocated is Rs. 1.5 Crores as per norms (not included in the project cost)		

9 Analysis of Proposal (Final Recommendations)

9.1 Financial and social benefits with special emphasis on the benefit to the local people including tribal population if any, in the area.

The industries, commercial establishments, HCUs which generate solid waste cannot afford to treat and dispose them scientifically, meeting MoEF&CC guidelines. An integrated common hazardous waste treatment and disposal facility is therefore required near the source of generation to solve environmental related issues. Hence the proposed project will be beneficial to the waste generators and helps in environmental protection.

Further, the proposed project will have a positive impact on the socio-economic conditions of the people. Due to the proposed project, employment options to the locals will be increased which will improve their livelihood.