

M/S. JINDAL URBAN WASTE MANAGEMENT (VISAKHAPATNAM) LIMITED

PRE- FEASIBILITY REPORT

For

PROPOSED SCIENTIFIC LANDFILL FACILITY

At

KAPULUPPPADA VILLAGE, BHEEMNIPATNAM
MANDAL, VISAKHAPATNAM DISTRICT,
ANDHRA PRADESH

SCHEDULE 7 (i) – COMMON MUNICIPAL SOLID
WASTE MANAGEMENT FACILITY (CATEGORY 'A')

ABC Techno Labs India Private Limited

An ISO : 9001:2008, ISO:14001:2004 & OHSAS:18001:2007 Certified Company

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1. INTRODUCTION

In Andhra Pradesh (AP), urban population has witnessed significant growth over the last fifty years. Andhra Pradesh has 110 Urban Local Bodies (ULBs) with a population of 135 lakhs (Census 2011) which has increased to 146 lakhs as per Municipal Administration and Urban Development Department (MA&UD), with AP registering a growth rate of 400% and urban population constituting 29.6% of the total population and it continues to grow at an accelerated pace. The significant growth is mainly due to the migration of people from rural to urban areas in search of better livelihood opportunities. With this increasing trend of urban population, there is an abnormal increase in generation of Municipal Solid Waste (MSW) quantities affecting health and environment. Segregation of waste at source, proper collection & transportation of waste, treatment & scientific disposal of waste has become a challenging task due to insufficient and inefficient systems in place thereby, leading to degradation of environment and poor quality of life.

The proposed project area comes under the jurisdiction of Visakhapatnam district of Andhra Pradesh. Proposed scientific landfill comes under Greater Visakhapatnam Municipal Corporation area, which has been divided into 6 zones comprising of 72 wards under Bheemnipatnam mandal in Visakhapatnam district. The total area available at Kapuluppada site is about 110 acres under GVMC, out of which 17.08 acres for WtE facilities and about 39.85 acres for scientific landfill. Out of 39.85 acres, 9.85 acres covered by hill and 19.66 acres covered by legacy waste in scattered manner. Rest of 50 acres of land can be used for the future development.

Scientific Landfill is one of the best suitable options for disposal of inert residues generated from the Waste to Energy plant. The process of land filling involves scientific disposal of waste in an eco-friendly manner protecting the environment. Guidelines are formulated by the Urban development department, Swachh Bharat Mission, State and Central pollution control board for design, construction and management of scientific landfills. Improper management of landfills can cause serious environmental damages causing groundwater, air and soil pollution and affects the surrounding communities. Therefore, scientific landfill needs appropriate design, construction and operation to reduce negative impacts on the environment.

Table 1.1: The Salient Features of the Project

Project Name	M/s Jindal Urban Waste Management (Visakhapatnam) Limited, Scientific Landfill facility																				
Location/Area	Survey No: 410, Kapuluppada Village, Bheemnipatnam Mandal, Visakhapatnam District, A.P. 531163. SLF facility Area : 39.85 Acres																				
Toposheet number	E44R5																				
S. L. Facility Capacity	<table><tr><th>Item</th><th>Unit</th><th>Cell 1</th></tr><tr><td>Average design capacity</td><td>T/day</td><td>375</td></tr><tr><td>No of years</td><td>years</td><td>13</td></tr><tr><td>Height of the landfill</td><td>m</td><td>30</td></tr><tr><td>Waste disposed in landfill</td><td>Tonnes</td><td>16,08,750</td></tr><tr><td>Total design capacity of landfill</td><td>m³</td><td>13,50,156</td></tr></table>			Item	Unit	Cell 1	Average design capacity	T/day	375	No of years	years	13	Height of the landfill	m	30	Waste disposed in landfill	Tonnes	16,08,750	Total design capacity of landfill	m ³	13,50,156
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Total design capacity of landfill	m ³	13,50,156																			
No. of working days	330 days																				
Water demand	50KLD																				
Sources of water	Ground water/Surface Water through Tankers																				
Man power	50																				
Nearest Railway station	Visakhapatnam R.S. ≈ 22 km, SW																				
Nearest Airport	Visakhapatnam Airport ≈17.5 km E																				
Nearest Village	★ Boravani palem ≈ 1.2 km, NW ★ Paradesi palem ≈1.72 km NW																				
Nearest Road	NH 5 – Chennai – Kolkata ≈ 1.0 km ,W																				
Water Bodies/ Reserve Forest	★ Kambalakonda wildlife Sanctuary ≈ 1.9 km, NW ★ Sitakonda R.F. ≈ 7.2 km, SSW ★ Kambalakonda Eco Tourism Park ≈ 7.8 km, SSW																				

2.0 INTRODUCTION OF THE PROJECT / BACKGROUND INFORMATION

2.1 Identification of Project and Project Proponent

Solid waste management has become a major environmental issue in India. The increase in population and urbanization are largely responsible for the increase in solid waste. Municipal Solid Waste (MSW) includes mostly residential waste, commercial waste and market waste, slaughter house waste, street sweeping etc. It consists of biodegradable waste, recyclable waste, inert waste, combustible and non-combustible waste etc.

Jindal Urban Waste Management (Visakhapatnam) Limited (JUWMVL), a subsidiary firm of Jindal Group has been awarded the contract for establishment of Waste to Energy (WtE) plant and scientific landfill at Kapuluppada under Bheemnipatnam Mandal in Visakhapatnam district by the state government of Andhra Pradesh in the year 2016 and the Greater Visakhapatnam Municipal Corporation (GVMC). M/s ABC Techno Labs India Pvt Ltd have been appointed by M/s Jindal Urban Waste Management (Visakhapatnam) Limited for providing technical consultancy and assisting in obtaining Environmental Clearance for proposed Scientific Landfill Facility. Present report is prepared for submission of Form1 & Pre-feasibility Report i.e. EC application to MOEF & CC for obtaining Environmental Clearance as per the guidelines of EIA Notification, 2006 of MoEF & CC, Government of India and its subsequent amendments.

2.2 Brief Information about the Project

The project area comes under the jurisdiction of Visakhapatnam, Andhra Pradesh. The proposed Sanitary Land Fill facility is located at Survey No. 410, Kapuluppada Village, Bheemnipatnam Mandal, Visakhapatnam District, A. P. 531163. The site is having red and brownish clayey sandy soil along with pebbles and boulders. The proposed project area is situated 1 km away from the National Highway 5, which runs from Kolkata to Chennai. The coordinates of SLF area are 17°50'19.60"N and 83°22'23.53"E. The project area is well connected by road with Visakhapatnam. Visakhapatnam Railway station is the major railway station which is 22 km from the project site. Nearest airport is at Visakhapatnam 17.5 km on E whereas Vizag sea port is 13 km away from the project site.

2.3 Need for the Project and Its Importance to the Country or Region

The MSW disposal is carried out in an unscientific manner by open disposal of mixed waste. The Government of Andhra Pradesh and GVMC, thus proposes to strengthen the MSWM system covering collection, segregation, recycling, transportation processing and disposal in ULBs so as to comply with the service level benchmarks of the Government of India and also to meet its goal of maintaining growth rates without jeopardizing the environment and its natural resources. The project area has been allocated by the GVMC to JUWMVL as the lead ULB for the cluster of all six zones. The land has been allotted for a period of 25 years to handle and manage the Municipal Solid Waste from GVMC including other ULBs and the residual inert matter generated from the Waste to Energy plant operations of JUWMVL. The land has been allotted by GVMC free of cost, the project will handle residues generated from the MSW incineration of JUWM (V)L Waste to Energy Plant operations.

2.4 PROPOSED SOLID WASTE MANAGEMENT FACILITIES

A proper and scientific Landfill facility upgrade significantly the living status of the people residing there and also ensure eradication of some of the major health related problems when combined with 100% compliance to clean sewerage facilities and pure drinking water supply in all the Wards.

The sanitary landfill site will handle the rejects from the MSW incineration of JUWML (Visakhapatnam) Waste to Energy Plant operations. Deposition of inert in conical heaps over the landfill site and spreading these heaps using a tracked bull dozer is a low cost and easy option.

2.5 Employment Generation

The proposed Sanitary Landfill Project will provide livelihood to the 50 people. It will provide employment to the people residing in vicinity.

3.0 PROJECT DESCRIPTION

M/s Jindal Urban Waste Management (Visakhapatnam) Limited, (JUWML) a subsidiary firm of M/s Jindal Group has been awarded the contract for establishment of scientific landfill facility at Survey No. 410, Kapuluppada Village, Bheemnipatnam Mandal, Visakhapatnam District, A.P. to implement facility for sanitary landfill. M/s Jindal Urban Waste Management (Visakhapatnam) Limited shall Implement Sanitary Landfill for 25 years.

3.1 Type of Project Including Interlinked and Interdependent Projects, If Any.

No interlinking project is proposed.

3.2 Location of the project

The proposed Sanitary Land Fill facility is located at Survey No: 410, Kapuluppada Village, Bheemnipatnam Mandal, Visakhapatnam District, A.P. The site consists of red and brownish clayey sandy soil along with pebbles and boulders. The proposed project area is situated 1 km away from the National Highway 5. The SLF area falls in the Survey of India topo sheet no. E44R5 with the co-ordinates of 17°50'19.60"N and 83°22'23.53"E. The satellite imagery is given in Figure No.1. Location map of the project site is shown in Figure No.2. Topo Map of the Project Site is shown in the Figure No.3.

The proposed project area for SLF facility is unevenly distributed. The proposed area has been demarcated with cement poles and fencing from the GVMC area & the private lands.

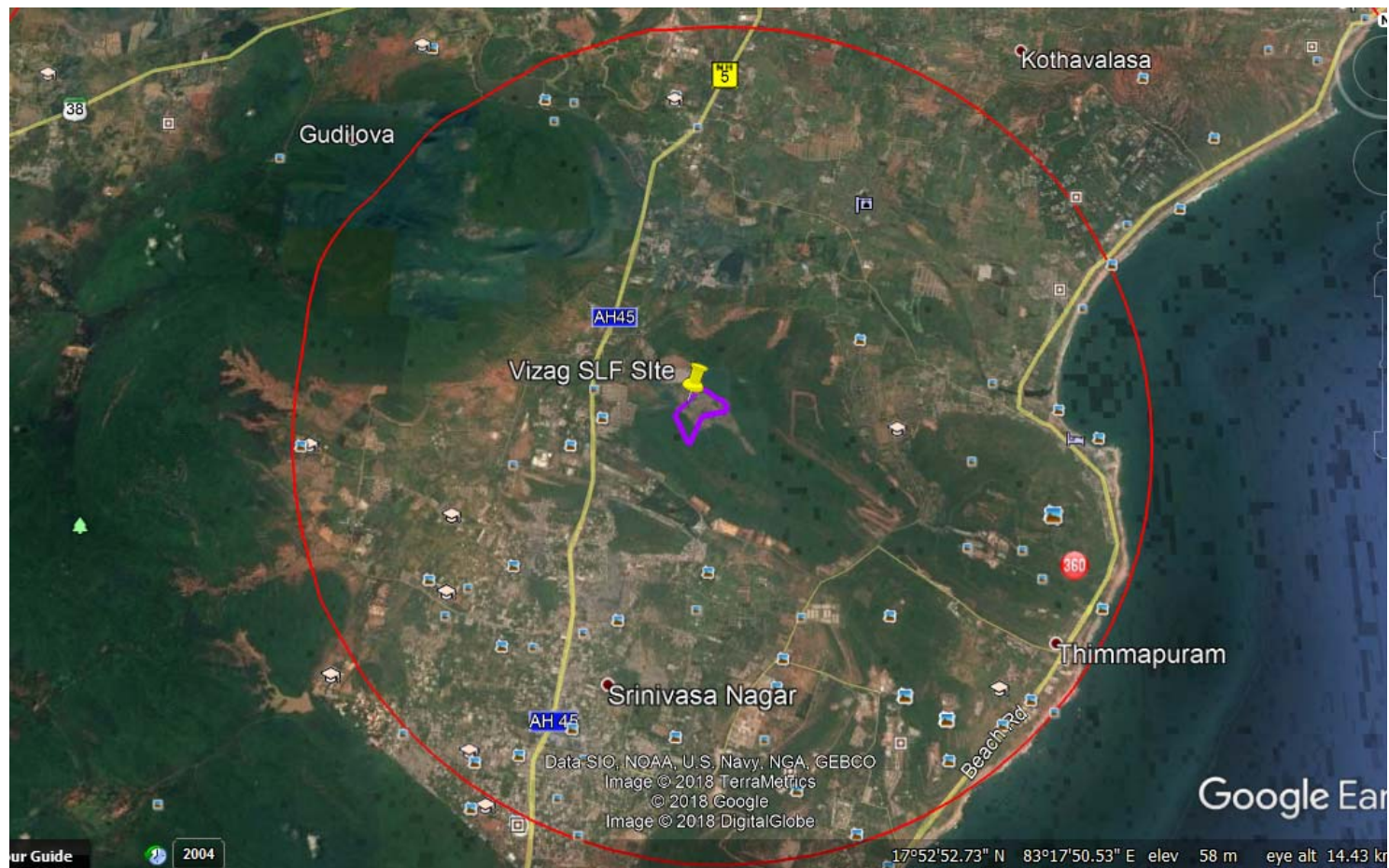


Figure 1: Satellite Imagery of the 5 km radius

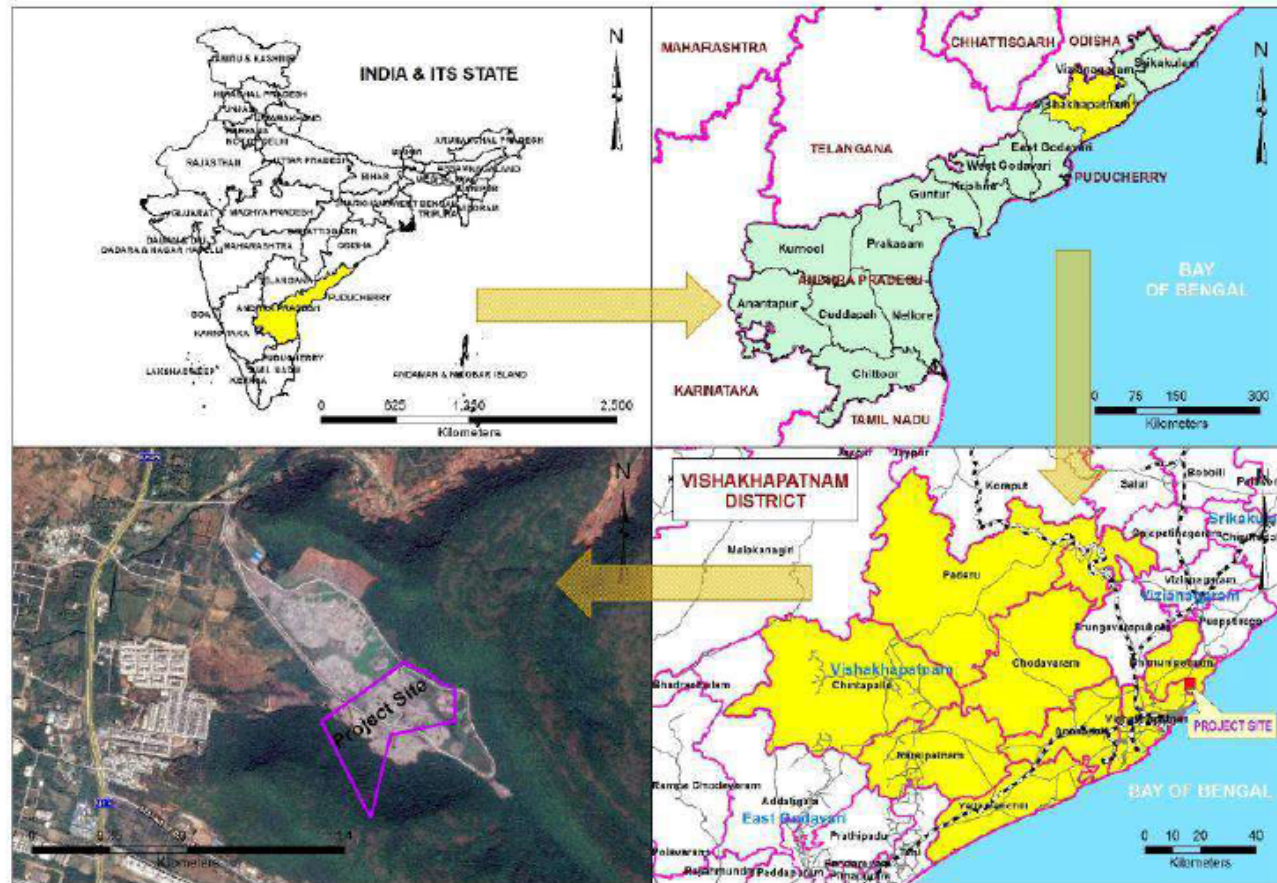


Figure 2: Location Map

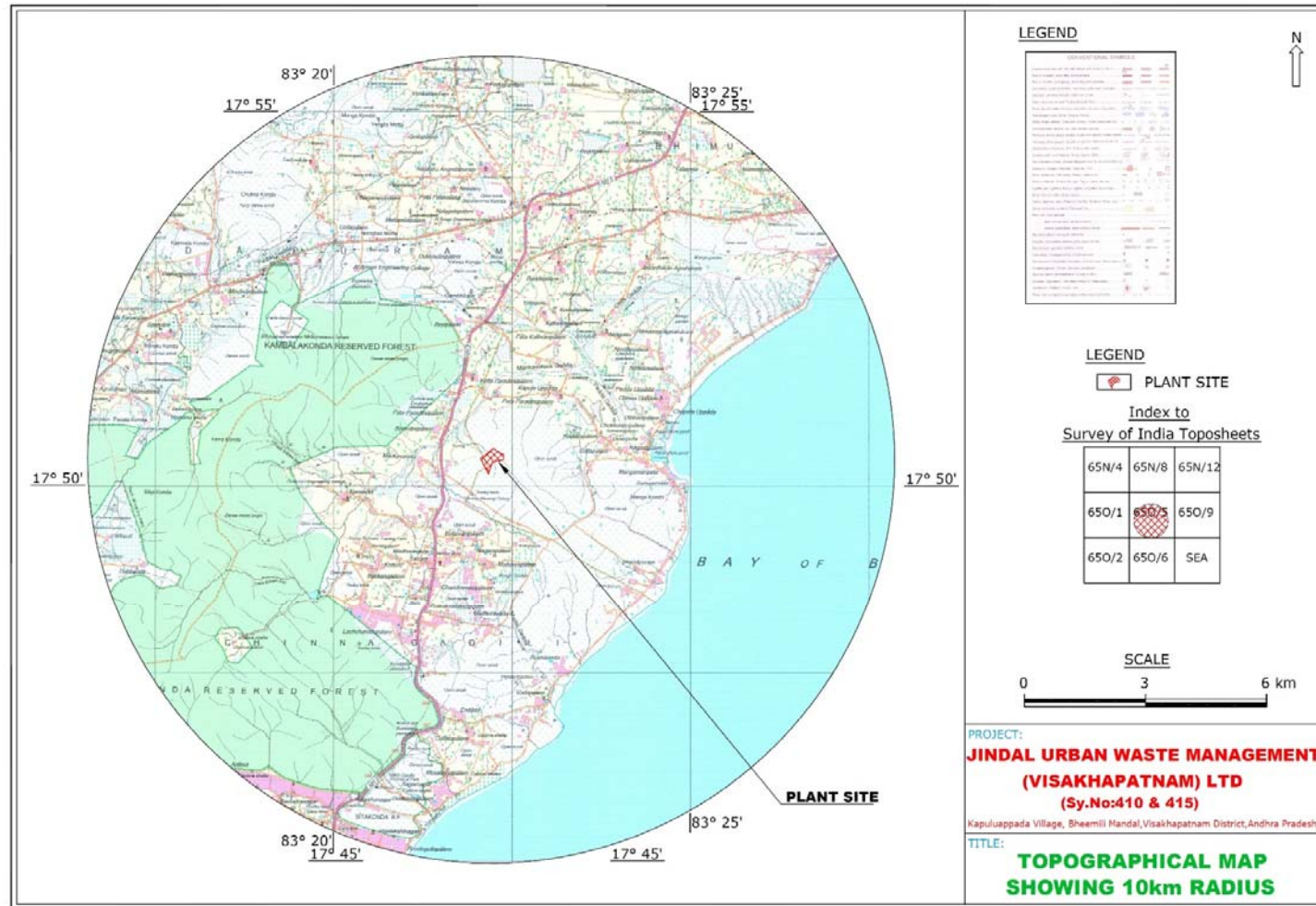


Figure No.3 : Topo Map of Project Site

3.3 Details of Alternate Sites

No alternate site was considered as the project location is already been used as dumping yard for GVMC.

3.3.1 Size or magnitude of operation

The scientific landfill proposed for Visakhapatnam has been designed for the disposal of process rejects and inert generated from WtE facility of JUWMVL. The process rejects include the bottom ash and residual material generated during the process of incineration. The proposed landfill is designed for a period of 25 years referring the terms and conditions mentioned in the concessionaire agreement and consent for establishment order. The design concept involves appropriate procedure and safety considerations. To develop the design for the proposed landfill, standard design procedure from CPHEEO manual, and SWM Rules 2016 have been adopted.

Considering the average waste generation of 1500 tonnes per day for 25 years, the landfill has been designed for approximately 25% of the total waste generation. This 25% has been calculated considering only bottom ash and un-burnt organics from the total waste to be incinerated in the WtE facility.

The total volumetric capacity of the landfill including the daily cover and the liner system is 28, 35,938 m³ for 25 years. Following assumption has been made to arrive at the foresaid volume:

- 10% of landfill volume have been considered for daily cover and base liner. These volume allowances are in accordance with the guidelines provided in CPHEEO manual for SWM.
- 330 days of operation has been considered
- The density of the waste at the landfill has been assumed as 1200 kg/m³.

3.3.2 Topography

The project area is situated on an undulating terrain and on the down hills of hillocks which forms the boundary of the northern, eastern and southern side of the proposed site. The land is sloping from southern to northern directions. Some portion of the southern part having elevation is about 185 m AMSL, whereas northern part of the site is varying from 51 - 52 m AMSL.

3.4 PROJECT DESCRIPTION WITH PROCESS DETAILS

SANITARY LANDFILL: Landfill Site & Design

Land filling shall be restricted to non-biodegradable, inert waste and other waste that are not suitable either for recycling or for biological processing. Land filling shall also be carried out for residues of waste processing facilities as well as pre-processing rejects from waste processing facilities. Land filling of mixed waste shall be avoided unless the same is found unsuitable for waste processing. Under unavoidable circumstances or till installation of alternate facilities, land filling shall be done by proper norms. Landfill sites and design shall meet specifications as given in MSW (Management & Handling) Rules 2016.

SWM Rules 2016 prescribe that landfilling should be restricted to non-biodegradable; inert waste and other waste that are not suitable for recycling or for biological processes including residues and pre processing rejects of waste processing facilities. SWM Rules 2016 also prescribe that landfilling of mixed waste should be avoided unless the same is found unsuitable for waste processing. The waste processing technology adopted for processing of waste in Visakhapatnam is controlled combustion (incineration) of solid waste. Bottom Ash and Fly ash are the major process remnants from the process of controlled combustion of solid waste. During the process of waste incineration, the ash discharged from the bottom of the incinerator is known as bottom ash, whereas the dust and ash collected in the filters and exhaust system is known as flyash. The proportion of bottom ash generated is 15 ~ 20% of the total volume of waste incinerated; the proportion of fly ash generated is 3~8% of the total waste.

As a by-product of the treatment of municipal solid waste in incineration plants, roughly 230-280 kg of ashes are generated per ton of waste incinerated, bottom ash being the major stream. Bottom ash is either land filled or utilized. The legislation and boundary conditions regarding the utilization of bottom ash appear to be different globally. Since a large quantity of solid waste incineration bottom ash is generated, the impact of byproduct utilization is large (both economically, environmentally and related to public acceptance). Recent experiences have shown that single events may influence the rate of utilization of bottom ash substantially. The mechanical properties of MSW incineration bottom ash has been studied in several countries. In general, the conclusion is that the MSW bottom ash can replace not only sand but also natural gravel in unbound layers (sub-base), if the content of un burnt organic matter is kept low. The most abundant elements in municipal waste combustor ash are silica, calcium, and iron. Although ash composition

can be expected to vary from facility to facility, these elements are present within relatively predictable ranges. This is reflected in the results presented in below table.

SN	Chemical	Percentage
1	Silicun	16.80-27.40
2	Calcium	5.12-10.30
3	Iron	2.11-11.5
4	Magnesium	0.19-1.18
5	Potassium	0.72-1.16
6	Aluminium	3.44-6.48
7	Sodium	2.02-4.80

The presence of a relatively high salt content and trace metal concentrations, including such elements as lead, cadmium and zinc in municipal waste combustor ash (compared with conventional aggregate materials) has raised concerns in recent years regarding the environmental acceptability of using ash as an aggregate substitute material. The presence of calcium and other salts in relatively high concentrations in MSW combustor ash makes the ash susceptible to hydration and /or cementitious reactions (particularly in the combined ash, which contains unreacted lime) and subsequent swelling. The presence of free aluminum in the ash when combined with water can also result in the formation of hydrogen gas. In addition, the high salt content also suggests that ash could be corrosive if placed in contact with metal structures, and that it would likely interfere with curing and strength development if used in Portland cement concrete.

At present, there are regulations for ash generated from Thermal Power plant but no regulations exist for the ash generated from the WtE Plants in India. Therefore, scientific landfill has been proposed for disposal of bottom ash to be generated from the WtE plant in Visakhapatnam.

The scientific landfill proposed for Visakhapatnam has been designed for the disposal of process rejects and inerts generated from WtE facility of JUWMVL. The process rejects include the bottom ash and residual material generated during the process of incineration. The proposed landfill is designed for a period of 25 years referring the terms and conditions mentioned in the concessionaire agreement and consent for establishment order. The design concept involves appropriate procedure and safety considerations. To develop the design for the proposed landfill, standard design procedure from CPHEEO manual, and SWM Rules 2016 have been adopted

3.4.1 Landfill area and life:

The total land available is 39.85 Acres for the development of scientific landfill facility for JUWMGL, with a total design period of 25 years.

Currently, waste is being dumped on the site without processing and compaction. No official records have been maintained for quantity of waste being dumped at the site. Based on the discussions with JUWMVL officials, it was indicated that approximately 1000 TPD of waste is being dumped on the site from last twenty-three years (since 1994) by Greater Visakhapatnam Municipal Corporation (GVMC). The waste is being dumped on site having total waste confined area of 79584 sq. m or 7.95 ha with an average waste height of 4.0 - 5.0 m. As per the topographic map provided by JUWMVL, 47% of the site area is covered by legacy waste. Approximately 3,97,920 m³ of waste is currently accumulated on the site. The accumulated waste should be cleared from site prior to development of scientific landfill facility.

The accumulated waste at site can be handled in following three ways:

- Shifted and doze the waste on one edge of the landfill and close the waste dump as per the standard methods and practices;
- Recover and reclamation of potentially useful material from the waste and disposal of inerts in the new landfill or stored on site for utilization as daily cover material for the landfill operation.

The ideal scenario for managing accumulated waste would be reclamation of potentially useful material from the waste and storage of inert for use as daily cover.

Design parameters

A scientific landfill typically comprises of following systems and components:

- Cover and liner system for adequate landfill cell protection, bottom lining, intermediate and final cover;
- Leachate collection, control and treatment system;
- Landfill gas collection/venting system;
- Monitoring systems: monitoring wells and basic laboratory.

For design of the landfill, standard design criteria prescribed in SWM Rules 2016 and CPHEEO manual has been followed.

Key design parameters

Key design parameters considered for the scientific landfill are as under:

- Considering the average waste generation of 1500 tonnes per day for 25 years, the landfill has been designed for approximately 25% of the total waste generation. This 25% has been calculated considering only bottom ash and unburnt organics from the total waste to be incinerated in the WtE facility.
- The total volumetric capacity of the landfill including the daily cover and the liner system is 28,35,938 m³ for 25 years. Following assumption has been made to arrive at the foresaid volume:
 - ✧ 10% of landfill volume have been considered for daily cover and base liner. These volume allowances are in accordance with the guidelines provided in CPHEEO manual for SWM.
 - ✧ 330 days of operation has been considered
 - ✧ The density of the waste at the landfill has been assumed as 1200 kg/ m³.
- Based on the current land availability, the landfill has been designed in two phases for approximately 13 years. The first phase being for 3 years and second phase for 10 years. The phase wise division has been done based on the site profile. The current site has the capacity to accommodate waste to approximately 13 years. Currently, there is no area available for future development.
- The total area requirement for development of landfill for balance 12 years of the concession period is estimated to be additional 35 acres. This has been arrived considering slope below the ground as 1:3 and slope for the cover system as 1:4. However, the final requirement can only be calculated based on topography of the land available and considering other site limitations.
- Since the terrain is uneven, considerable cut and fill requirement have been estimated for development of facility. The exact requirement of cut and fill has not been estimated at this stage.
- The depth of the landfill has been assumed approximately 6 meters high from the post monsoon water level on site. Though the ground water level is at a depth of 21 to 24 meters. Considering the topography of the site and increase in cost of excavation at a depth more than 6 meters from the ground level, the depth of the

landfill has been limited to 6 meters. Since the terrain is hilly, the relative depth of the landfill base from the ground level will vary at different places on site. Similarly, the height of each section from different points on site will be different. The parameters like volumetric capacity, life and average waste disposed in different phase is provided below

Landfill development – Phases wise details

Item	Unit	Cell 1
Average design capacity	T/day	375
No of years	years	13
Height of the landfill	m	30
Waste disposed in landfill	Tonnes	16,08,750
Total design capacity of landfill	m ³	13,50,156

- The design of the liner and the cover system has been proposed based on the guidelines provided in CPHEEO manual. The guidelines primarily prescribe construction of a non-permeable lining system at the base and sides of waste disposal area having a composite barrier of 1.5 mm. High Density Polyethylene (HDPE) geomembrane or equivalent, overlying 90 cm of soil (clay/amended soil) having permeability coefficient not greater than 1×10^{-7} cm/sec.
- Leachate Conveyance System is a network of perforated HDPE pipes laid on the drainage layer. The primary function of Leachate Conveyance System is to collect and convey leachate out of the landfill unit and to control the depth of the leachate above the liner. The leachate collection system should be designed to meet the hydraulic performance standard of maintaining less than 30 cm depth of leachate or head above liner. Feeder pipes (100mm) and header pipes (250 & 150 mm) have been proposed for collection and conveyance of leachate. The drainage layer has been proposed as 300 mm thick rubble having permeability not less than 10^{-2} cm/sec.
- It has been estimated that maximum quantity of leachate generated from the cell during the active life of the landfill (assuming average rainfall of 1202 mm per year according to the information available at official website of Visakhapatnam (<http://visakhapatnam.nic.in/district-profile.html>), 65 rainy days and cell area of 67,241 m²) is 60 m³/day. Leachate generated from the landfill will be stored in the leachate sump. The capacity of the sump is sufficient to collect and store leachate

for two days. The leachate shall be carried in tanks to the leachate treatment facility of the WtE facility for treatment and disposal.

- The cover system proposed for the project is in line with the specifications provided in SWM Rules 2016. Passive vents shall be provided at the time of final cover placement over the cells to ensure that excess gas pressures do not build up below the landfill cover. The placement of one vent per 5,000 m² of cover will be adequate.
- Access road has been proposed from site entrance to the landfill working face with a load bearing capacity of minimum capacity of 40 Ton/m² and width of 15 m
- Vegetative cover in a strip of minimum 20 m width around the site boundary of scientific landfill facility
- Weighbridge has been proposed at the entry of the facility

The layout of the landfill proposed for Visakhapatnam is given in Figure No.4, 5, 6, 7 & 8

Total land available for development of facility is 39.85 acres (approximately 16.12 ha).

The land currently available for disposal of waste is 30 acres which is sufficient to accommodate the process rejects from WtE plant for only 13 years. Additional area available is 9.85 acres and was not found suitable for development of landfill facility.

The land area requirement for facility component including treatment and disposal facility is summarized below.

SN	Parameter	Units	Area
I	Total available area	m ²	161252
A	Landfill		
1	Cell	m ²	121317
	Total landfill (13 years)	m ²	121317
B	Common infrastructure for Facility		
1	Roads(7meter width)	m ²	9062
2	Roads(15meter width)	m ²	314
3	Green belt (20meter width)	m ²	27655
4	Leachate Collection Tank	m ²	12.5
6	Guard Room	m ²	15
7	Landfill Vehicle parking	m ²	600
8	Panel Room	m ²	20
	Total common Infrastructure	m ²	37,679
1	Weighbridge with cabin	m ²	104

Note: Area for circulation and other space utilized is not shown in the above table

Volume of Cell:

The cell has been designed with an area of 121317 m² considering the depth of landfill as 6 m with 1:2 slope and height of landfill as 30 m with 1:3 slope. The total volume of landfill is 1350156 m³. The active life of cell for the proposed capacity is around 13 years. 1 bench has been provided at 7 meters.

Active life of Landfill:

The active life of the landfill is the period of landfill required for waste disposal. After assessment of the volume capacity within two cells, the total life of the landfill is estimated to be around 13 years. To meet the requirement of landfill for a period of 25 years, more land should be acquired to meet future requirement.

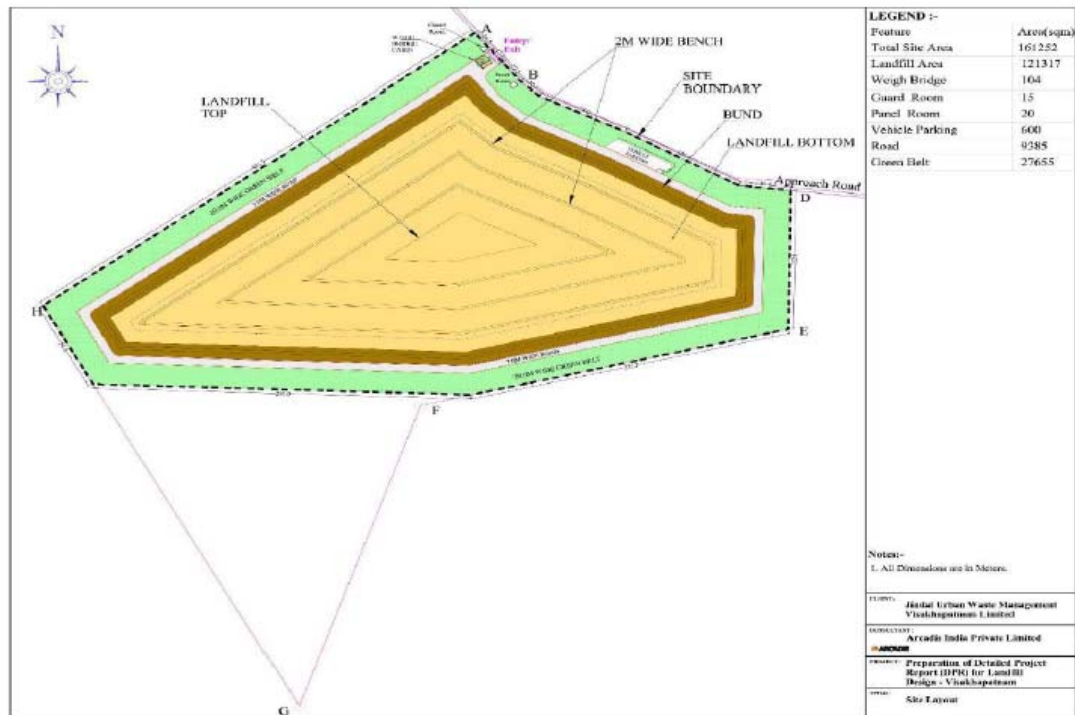


Figure No. 4 : The layout of the landfill proposed for Visakhapatnam

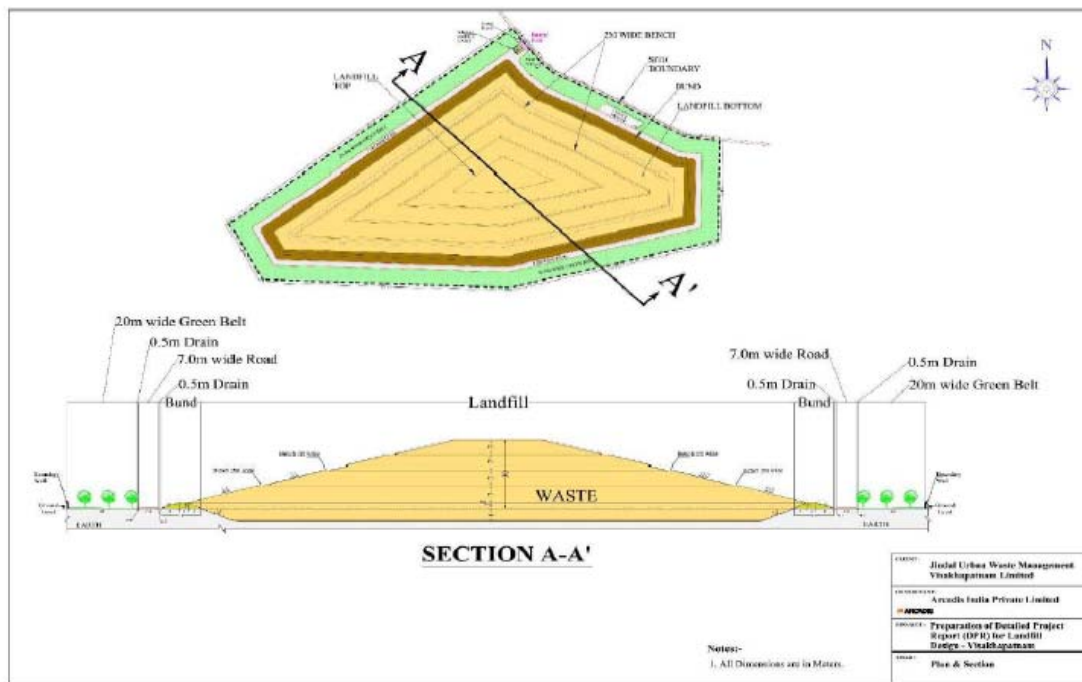


Figure No.5: Landfill Section for Visakhapatnam

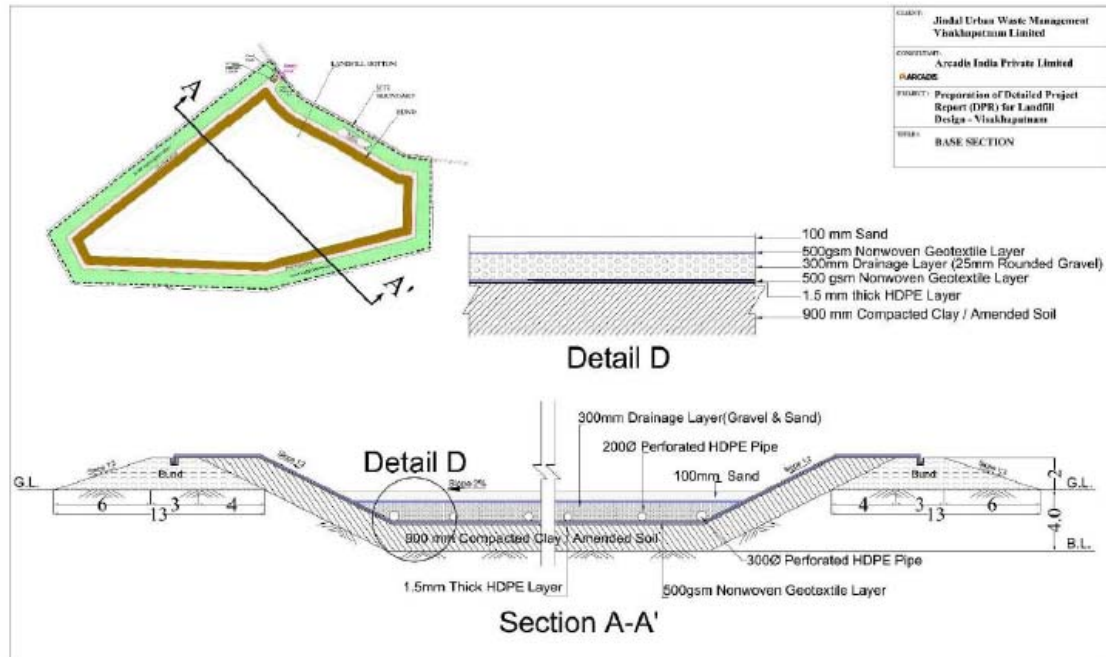


Figure No.6: Landfill Base Section for Visakhapatnam

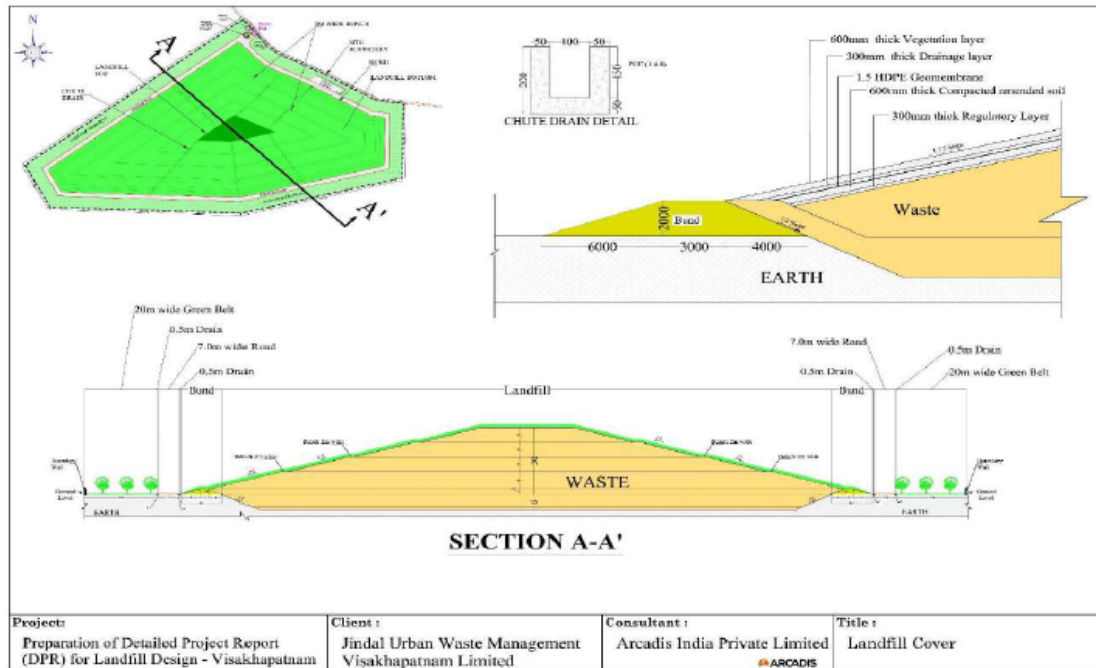


Figure No.7: Scientific Landfill Facility Closure Plan for Visakhapatnam

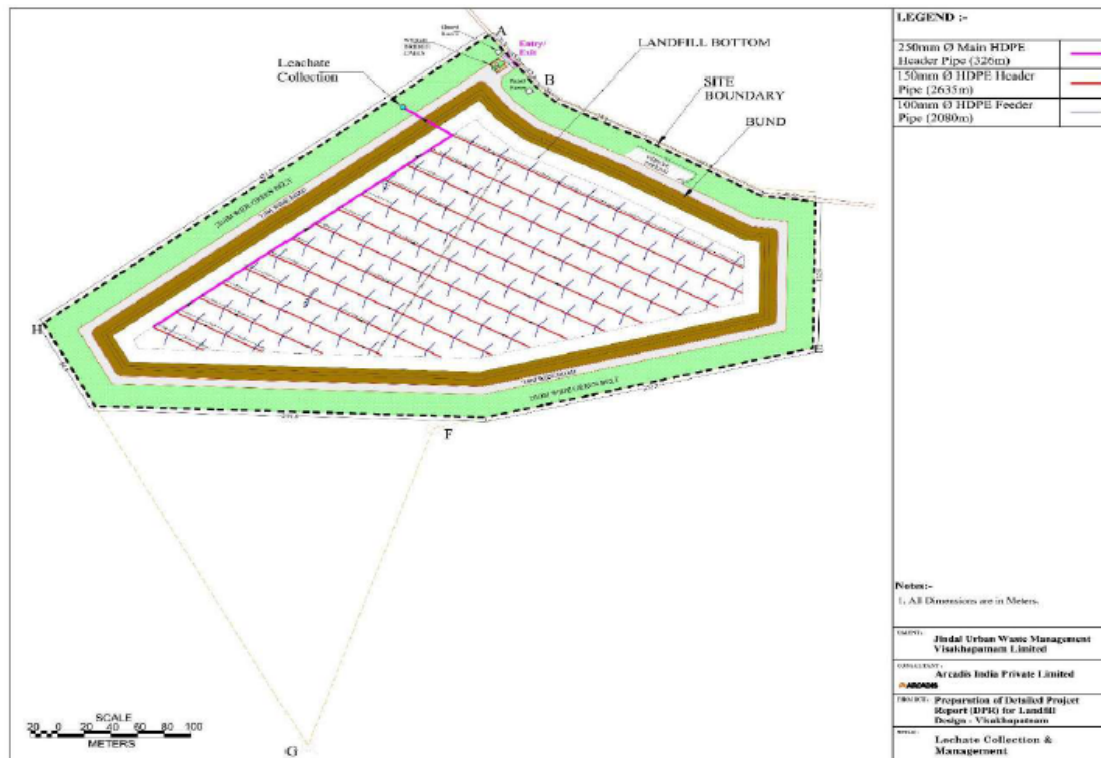


Figure No.8: Leachate Collection Plan for Visakhapatnam

3.4.2 SCIENTIFIC LANDFILL FACILITY DESIGN COMPONENTS

Bottom Liner

The lining system is the major component of landfill. It helps as a barrier between the landfill material and subsoil of landfill. The liner system acts as a protective system by prevention of percolation of leachate into sub soil and ground water. The liner system is a combination of barrier layers such as natural clay, amended soils and flexible geomembrane and also comprises of drainage layer. The selected liner system should have low permeability and should be robust, durable and should have chemical and mechanical resistance.

The strength and effectiveness of the barrier depends upon the hydraulic conductivity of the clay liner and HDPE geomembrane. The landfill liner system is designed based on the guidelines of MoEF & CC, CPHEEO and SWM Rules 2016. MoEF & CC guidelines recommends "Construction of a non- permeable lining system at the base and walls of the landfill. The proposed liner system is designed for the disposal of bottom ash and other inert residual inert matter.

The landfill composite liner with the following specifications has been recommended complying with the guidelines of SWM Rules 2016 and CPHEEO.

- A 900 mm thick layer of compacted clay or amended soil (with bentonite) of permeability of not greater than 1×10^{-7} cm/sec.
- A HDPE geomembrane liner with thickness of 1.5 mm.
- A 300 mm thick granular drainage layer with a permeability not less than 10^{-2} cm/sec.

The components of composite liner system comprise of clay/amended soil layer and geomembrane liner. The performance of landfill depends upon the liner system. Thus, the landfill liner system has been designed depending on the type of nature of the landfill material following the prescribed norms.

Leachate Collection System

The system of collection of leachate generated within the landfill unit is known as leachate collection system. Leachate is a liquid material generated from the decomposition of the biodegradable material of landfill. The composition and characteristics of leachate depends on the concentration of suspended solids and soluble materials of the waste. The system has been designed to meet the hydraulic performance standard by maintaining the depth

of leachate below 30 cm. The flow of leachate into liner system through imperfections increases with an increase in the leachate head above the liner. The performance of the composite liner shall be increased by controlling the level of leachate.

The leachate collection system comprises of drainage layer and conveyance system. The leachate conveyance system is a network of HDPE perforated pipes connected to the collection sump. The leachate collected through the collection system shall be pumped to the collection sump by periodical monitoring of the level of accumulated leachate. The drainage layers and collection system shall be designed as per the standards mentioned in SWM Rules 2016 and CPHEEO guidelines.

3.4.3 Assessment of Leachate Quantity:

Precipitation is the common phenomena for generation of leachate. The amount of leachate generation is directly proportional to rainfall intensity and surface area of landfill. To calculate the maximum level of leachate generation, data from the Indian Metrological Department (IMD) and Central Ground Water Board, Visakhapatnam has been considered. Along with the rainfall data, surface area of landfill plays an important role in assessment.

Landfill Area of Cell (excluding bund area) (A1) = 67241 m²

Average rainfall = 1202 mm i.e. 1.202 m

No. of Rainy days= 65

Percolation Coefficient (K)=0.05

Quantity of Leachate Generation in A1 = $KIA = 60\text{m}^3/\text{day}$

Leachate collection system:

The leachate collection system consists a combination of lateral pipes and header pipes. The size of lateral pipes shall be 100 mm diameter, whereas the size of header pipes shall be 150 and 250 mm diameter. The pipes with maximum diameter are suggested to maintain the uniform flow and to take care of clogging and algal growth. The pipes should be HDPE perforated pipes with sufficient strength (minimum 6kgf). The leachate accumulated in lateral pipes reaches the header pipe. The header pipe is directly connected to leachate collection sump. The size of the sump considering 2 days storage for Cell shall be 120 m³. The leachate sump has been provided in the layout considering the topography and natural slope.

Closure system

The final cover system shall be started immediately after completion of active period of landfill. This system shall be designed to minimize the infiltration and erosion, to enhance surface drainage system for storm water management and to support vegetation.

- The first layer composed of regulatory layer with thickness of 300 mm.
- The second layer comprises of 600 mm thick clay or amended soil layer with permeability coefficient less than 1×10^{-7} cm/sec.
- The third layer will be HDPE geomembrane with thickness of 1.5mm.
- The fourth layer shall be drainage layer with a thickness of 300 mm for storm water management.
- A vegetative layer over the top of the landfill with a thickness of 600 mm to fit the landfill to the surrounding environment.

3.4.4 Operation of the Landfill site

A landfill is operated in phases because it allows the progressive use of the landfill area, such that at any given time a part of the site may have a final cover, a part being actively filled, a part being prepared to receive waste, and a part undisturbed; The term 'phase' describes a sub-area of the landfill. A 'phase' consists of cells, lifts, daily cover, intermediate cover, liner and leachate collection facility, gas control facility and final cover over the sub-area.

The term 'cell' is used to describe the volume of material placed in a landfill during one operating period, usually one day. A cell includes the solid waste deposited and the daily cover material surrounding it. Daily cover usually consists of 15 to 30 cm of native soil that is applied to the working faces of the landfill at the end of each operating period.

Waste subjected to land filling shall be compacted into thin layers using landfill compactors to achieve high density of the waste. Waste shall be covered and well compacted at the end of each working day with minimum 10-15 cm of soil, inert debris or construction material.

Prior to the commencement of monsoon season, an intermediate cover of 40-60 cm thickness of soil shall be placed on the landfill with proper compaction and grading to prevent infiltration during monsoon. Proper drainage shall be constructed to divert run off away from the active cell of the landfill.

A lift is a complete layer of cells over the active area of the landfill. Typically, each landfill phase is composed of a series of lifts. Intermediate covers are placed at the end of each phase; these are thicker than daily covers, typically 40 to 65 cm and remain exposed till the next phase is placed over it. A bench (or terrace) is commonly used where the height of the landfill will exceed 5 m. The final lift includes the cover layer.

The final cover layer is applied to the entire landfill surface of the phase after all landfilling operations are complete. The final cover usually consists of multiple layers designed to enhance surface drainage, intercept percolating water and support surface vegetation. The final cover shall have a barrier soil layer comprising of 60cm clay or amended soil with permeability coefficient less than 1×10^{-7} cm/sec. On the top of barrier soil layer, there shall be a drainage layer of 15cm. on top of the drainage layer, there shall be a vegetative layer of 45cm to support natural plant growth and to minimize erosion.

Daily Operation

For an organized operation of the site total area & volume should be calculated and the area should be divided into different sub-plots or cells. Due to the concentration of rainfall during monsoon, movement within the landfill site becomes difficult in this season. It is thus desirable that a few sub plots near the entrance are used during the monsoon. The subsidiary roads in the monsoon section will have be very carefully located and constructed for smooth and safe movement of refuses vehicles and the bulldozers that would be used.

The space between 2 adjacent vehicles unloading at site is 4 m. The vehicle approaches the unloading point in reverse gear, unloads and moves out in 5 –10 minutes. The incoming vehicle is directed form the main road to the sub road and then to the working face of the cell hydraulically and unloaded in 5 – 10 minutes.

A single pass of a bulldozer moving in the transverse direction will level the deposited waste. As subsequent loads are unloaded and leveled the bulldozer operator will ensure that at least three passes are made over every deposited refuse load.

Experience has shown that three passes should achieve the requisite compaction. These passes are made one after another by the movement of bulldozer or while levelling subsequent loads. In this manner the entire cell should be planned and after filling the cell by solid waste it should be covered with a 15 cm cover layer on the top as well as on the sides. After completion of one cell the second cell is taken up.

During filling of one sub plot the adjacent sub plot should be prepared and designed for filling. In this manner the whole plot should be filled and covered. The cell should have a side slope of 2:1. However, cells on the periphery should have 60 cm thick cover. There must be a provision to collect runoff water if there is a sudden rainfall. Garland drainage should also be provided at the site.

Subsequently, the second layer of cells will commence again from sub-plot – 1 from where filling should begin and the other sub plots should be filled in the same sequence as used in case of the first lift. By adopting this procedure the desired lift height will be reached when the top is provided with a 30 cm intermediate cover layer instead of 15 cm. In this method of operation, the cover material requirement is high.

In the 'multiple lift' method of operation, the cover material requirement is much less. In this method collection trucks dump the waste at the top of the slope where upon the dozers would be employed to compact the waste up the slope in 1 m thickness. In this manner the cells would be raised to the lift height to the pre-selected width (30-40 m) by a length equal to the days deposit. Daily cover would therefore be necessary only on the sloped face of the cell.

Alternately, a movable tarpaulin could be used as a cover over the sloped face to prevent waste from exposure. This method requires less cover material. After an intermediate cover has been laid, the second stage should commence by leaving a 3 m clear berm on the outer periphery. This berm should be provided with a 2 % slope towards the edge of the landfill and would also have vegetation, which would result via larger proportion of the rainfall flowing away as surface runoff. Adopting this procedure should continue the filling. When the maximum height is reached a final 60 cm thick cover layer with compaction is provided over the entire exposed top surface of the landfill. This thickness is expected to be adequate to prevent the rate from gaining access to the organic material, prevent the generated bio-gas from escaping (except through the outlets specifically provided) and prevent any fire from a cell from deteriorating to other portions of the landfill.

The movement of a bulldozer over the deposited waste results in primary consolidation achieved by compaction and dynamic forces resulting in rearrangement of particles and voids to give higher density. Secondary consolidation occurs after this stage. This occurs due to stabilization of organic matter and it results in higher density. Thus, the total

settlement of the deposited waste depends upon initial compaction, waste characteristics, and depth of over burden, degree of decomposition.

Following steps to be taken into consideration during Daily Landfill operation

- Waste should be spread in thin layers and preferably compacted to achieve high density of waste.
- Bulldozer shall be used daily for spreading and compacting the wastes and covering it with inert material.
- The waste may be covered on daily basis with 7.5cm to 10cm thickness of inert material such as construction waste or soil to avoid any foul smell and breeding of rodents and insects.
- Waste should not be allowed to be burnt at the landfill site to avoid air pollution.

Records to be maintained of date, time and quantity of waste received at site and the number of trips made by each transportation vehicle.

3.5 Raw Material Required Along With Estimated Quantity, Likely Source, Marketing Area of Final Product/S, Mode of Transport of Raw Material and Finished Product

Waste dumping in the proposed project area is practiced since 1994; about 1000 TPA of mixed solid waste is being dumped in the project area. The total quantity of legacy waste in the proposed project area is 3,97,320 m³ as per the latest survey details available with JUWMVL. Considering the average waste generation of 1500 tonnes per day for 25 years, the landfill has been designed for approximately 25% of the total waste generation. This 25% has been calculated considering only bottom ash and unburnt organics from the total waste to be incinerated in the WtE facility. The project area has been allocated by the GVMC, the lead ULB of the cluster of six ULBs to the JUWMVL. The land has been allotted for a period of 25 years.

Waste Generation at six ULBs and Distance to the Proposed Site

Sl. No	Name of the Area	Waste Generation per Day(MT)	Distance to proposed site (Km)
1	Mudasarlova	170	20.2
2	Appugarh	150	16.0

3	Town Kotha Road	400	21.2
4	Thatichetlapalem	120	20.2
5	Gajuwaka	100	34.4
6	Vepagunta	60	28.6
	Total (Qty)	1000	

3.5.1 Processing

No processing at site is involved. The proposed project is for Sanitary Landfill only.

3.6 Availability of Water Its Source, Energy/ Power Requirement and Source

3.6.1 Water Requirement

During construction phase, treated grey water will be used for construction activities which will be sourced through authorized tanker supply for construction works. The water demand for the project during the operation phase has been estimated to be about 44.187 KLD out of which water requirement of 25 KLD will be met through utilization of treated leachate. The remaining requirement of 19.187 KLD will be met through water tankers from nearby villages.

3.6.2 Power Requirement: 250 kVA D.G set is required for auxiliary power backup.

4.0 SITE ANALYSIS

4.1 Connectivity

The project area is well connected by road, NH 5 is about 1 km on W from project site.

4.1.1 Nearest Railway Station

Visakhapatnam railway station is the major railway station which is 22 km from the project site

4.1.2 Nearest Airport / Sea Port

Nearest airport is at Visakhapatnam and is about 17.5 km on E and Vizag sea port is 13 km away from the project site.

4.2 Landform, Land use And Land Ownership

The proposed area has been allotted to JUWML by GVMC for construction of scientific land fill facility. The land has been allotted for a period of

25years to handle the Municipal Solid Waste from GVMC and surrounding ULB's and the residues generated from the MSW incineration of JUWMVL Waste to Energy Plant.

4.4 Climatic data from secondary sources

The average annual rainfall of the district is 1202 mm.

5.0 PLANNING BRIEF

5.1 Planning Concept

The proposed area has been allotted to JUWMVL by GVMC for construction of scientific land fill facility to handle the Municipal Solid Waste from GVMC and surrounding ULB's and the residues generated from the MSW incineration of JUWMVL Waste to Energy Plant.

5.2 Population projection

The project will employ mostly workers from nearby villages. There will not be any increase in population due to the project.

5.3 Land use planning

The project site is Government land. Total land available for development of facility is 39.85 acres (approximately 16.12 ha). The land currently available for disposal of waste is 30 acres which is sufficient to accommodate the process rejects from WtE plant for only 13 years. Additional area available is 9.85 acres and was not found suitable for development of landfill facility.

The land area requirement for facility component including treatment and disposal facility is summarized below

SN	Parameter	Units	Area
I	Total available area	m ²	161252
A	Landfill		
1	Cell	m ²	121317
	Total landfill (13 years)	m ²	121317
B	Common infrastructure for Facility		
1	Roads(7meter width)	m ²	9062
2	Roads(15meter width)	m ²	314
3	Green belt (20meter width)	m ²	27655
4	Leachate Collection Tank	m ²	12.5
6	Guard Room	m ²	15
7	Landfill Vehicle parking	m ²	600

8	Panel Room	m ²	20
	Total common Infrastructure	m ²	37,679
1	Weighbridge with cabin	m ²	104

5.4 Assessment of Infrastructure Demand (Physical & Social)

On the basis of the preliminary site visit, the infrastructure demand in the villages was assessed on the basis of need and priority. The existing infrastructure is satisfactory but the approach road has to be maintained regularly.

5.5 Amenities / Facilities

Site Services like Work shed, First Aid, Drinking water as required will be provided within the project site.

6.0 PROPOSED INFRASTRUCTURE:

The project is Scientific Landfill Facility.

6.2 Residential Area (Non Processing Area)

As the local persons will be given employment, no residential area/ housing is proposed within the project area.

6.3 Green Belt

A green belt should be developed as per provisions of SWM Rules 2016. The greenbelt will be developed after the site is in operation. Tree plantation is proposed along boundary of site. The tree plantation will increase the aesthetical appearance of the site at the same time, it will prevent littering of the waste. The greenbelt shall be maintained during the entire duration of the concession period and post closure. Green belt will be developed in an area of 27655 Sq.M.

6.4 Water Management

Construction Phase: A septic tank shall be provided to treat the domestic wastewater generated due to labor settlements. Temporary facility would have impermeable flooring and proper leachate collection arrangement.

Operation Phase: During initial composting i.e. for about 3 days, leachate will be released. This leachate shall be utilized to maintain required moisture level in composting pits. However the excess leachate discharged shall be collected and treated before draining.

The small quantities of leachate generated will be collected in the sump and treated in Leachate Treatment Plant which will comprise of a settling tank, aeration system and treatment with suitable chemicals. This treated leachate will be used for gardening.

Excessive leachate generation in monsoon season will be combated by covering the sub-cells of the facility during rain with HDPE sheets and ensure that no water comes in contact with the waste. The water balance details are given below.

WATER BALANCE

Project activities requiring water	Facility Water Requirement			Wastewater/ Leachate Utilization (ltrs)			Balance to be met through tankers (ltrs.)
	Per Unit Requirement (ltrs.)	No. of units/ Area	Total liters required	Treated	Untreated	Total WW/ leachate utilization	
Vehicle washing	100	25 Vehicles /day	2500	2500		2500	0
Workers (Assumed 50 persons)	70	50 workers/day	3500	-		-	3500
Green belt/ Landscaping	1	27655 Sq/M	33187			20000	13187
Floor washing & Miscellaneous	5000	1	5000	2500	-	2500	2500
			44187			25000	19187
Total Water (KLD)			44.187			25	19.187

6.5 Air Quality

Comparing the baseline air quality along with predicted increase in SPM, the increase would be still within the stipulated ambient air quality levels for the residential areas. However, following mitigation measures are proposed to reduce the dust levels in the ambient air environment:

- Maintaining and/or re-establishment of a grass cover on area where there is no On-going activity
- Frequent watering of unsealed roads and stockpile area-cover material
- Blacktop of the roads as and when they are settled and ready for the same
- Repair, relaying of blacktop roads from the landfill area to the main road
- Using dust control sprays during loading and unloading of wastes
- Ceasing dust generating activities during high wind times
- Minimizing working distances for internal transport of wastes
- Periodical monitoring of ambient air quality for all relevant parameters as indicated in the monitoring plan
- Odor control by rapid stabilization and disposal of wastes at the earliest along with daily cover placement. The above mentioned measures will help in minimizing the fugitive emissions and dust.

6.6 Noise Management

The sources of noise generation in the facility will be from the generators, heavy earth machinery and plant machinery in addition to the vehicular movement. While all noise levels are well within the acceptable limits the following strategies would be adopted to further minimize the noise levels:

- Maintaining the site machinery in good operating condition
- Regular maintenance of systems and installation of noise control equipment wherever required
- Development of green belt all around the site
- Periodical monitoring of noise levels

6.7 Health And Safety Management

The health and safety of all those who work at the Plant shall be ensured by:

- Assessing the risk of all work activities, recording the significant findings and developing method statements as appropriate.
- Providing and maintaining safe plant and systems of work, together with appropriate personal protective equipment.
- Minimizing risks associated with hazardous substances including waste to be processed, materials used and the by-products of waste treatment processes

- Minimizing risks associated with other occupational health risks including noise, vibration and manual handling
- Maintaining the Plant in safe condition including as regards workplace transport and fire risks
- Providing appropriate information, instruction, training and supervision to those working at the Plant or visiting the Plant, including information and training with regard to the emergency procedures
- Implementing effective systems for active and reactive monitoring of compliance, including by inspections, audits and incident/ near miss investigation
- All personnel attending site, shall be equipped with Long Sleeves work clothes, Safety Helmet, Safety Boots, Hi-Vis vest or jacket and Safety Glasses which shall be worn at all times whilst working in the construction area.

6.8 Industrial Waste Management

The project is Municipal Solid Waste, Sanitary Land Fill Facility. The recoverable hazardous items would be disposed of to recycling agencies or sent to secure land filling after sorting out carefully from the dry and wet waste segregation lines. The ultimate rejects after processing would be stored in a separate place for placing it in a secured landfill with proper liner systems

7.0 REHABILITATION AND RESETTLEMENT (R&R) PLAN

The proposed project is new project at Visakhapatnam Municipal solid waste dumping site located at Survey No:410, Kapuluppada village, Bheemnipatnam Mandal, Visakhapatnam District, Andhra Pradesh. Rehabilitation And Resettlement (R&R) Plan is not applicable for the project.

8.0 PROJECT SCHEDULE & COST ESTIMATES

The total cost of project would be around Rs. 30 Crores

9.0 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.

Development of the facility will create more jobs in the area both in construction and operation phase and also present the opportunity to provide improved products or services

to people in the area. The jobs offered will be terms of waste diversion, disposal and green energy facilities for the next twenty years. There will be continued services to customers for waste disposal.

With the establishment of the facility and improvement in road access is likely to increase employment/ business opportunities along the road-side and periphery of the facility, Urban Local Bodies (ULBs) across India face challenges pertaining to storage, transportation, handling and disposal of municipal solid waste generated. The proposed Scientific Landfill Facility to be developed at Kapuluppada Village will manage 375 TPD of municipal waste in an environmentally sustainable manner with an emphasis on maximizing resource use efficiency. The facility will make a significant contribution in diverting the municipal waste reaching the landfill sites and also reducing the load on the existing waste management/ processing facilities in the Visakhapatnam City. Moreover the project will also involve closure of existing dumpsite through capping of the existing municipal waste in a scientific manner.

The leachate generated from waste receiving pits, vehicle washing areas, closed landfill, etc. will be collected by well-designed infrastructure and then treated in Leachate Treatment Plant. The treated leachate will be recycled in the process as well as reused within the Facility in landscaping. Other environmentally sustainable solutions such as rainwater harvesting plan, storm water management, solar lighting, greenbelt development, noise barriers have also been included in the project design.

All possible environmental attributes such as air quality, noise quality, soil quality, water, ecology, and socio-economic aspects have been adequately assessed and necessary mitigation measures have been formulated to meet statutory requirements. The project will result in improving the sanitation of the city in compliance with the Solid Waste Management Rules, 2016 and amendments thereof.