GOVERNMENT OF WEST BENGAL
OFFICE OF THE CHIEF ENGINEER
Municipal Engineering Directorate

Bikash Bhawan, South Block (1st Floor) Salt Lake, Kolkata – 700091.
Phone No: (033)2337-1331/ (033)2358-3347Fax: (033) 2337-5474
E-mail: ce_medte@yahoo.com

No. ME/ ***Dated***

From: The Chief Engineer,
Municipal Engineering Directorate.

To: ***The Director, SUDA***
&
Mission Director, Sachh Bharat Mission,
ILGUS Bhaban, H.C.Block, Sector-III,
Salt Lake, Kolkata- 700106.

Sub: Appraisal of DPR for Solid Waste Management Project within Siliguri Municipal Corporation.

Ref: (i) SUDA file no-SUDA – 161/2017
(ii) This office Memo no. ME/509/10S-15/96 Pt.-VIII dt. 02.06.17
(iii) Email of Sri G. Vijay Kumar, Under Secretary to GoI, MoUD dt. 08.06.17.

Sir,

With reference to the subject cited above and referred correspondence it is quite clear that the DPR for Solid Waste Management Project within Siliguri Municipal Corporation has already been approved by MoUD, GoI under Capacity Building for Urban Development (CBUD) Project.

Hence, further appraisal from this end may not be required at all. So, the referred file along with available document of appraisal from MoUD, GoI is hereby returned back for your kind perusal.

Yours faithfully

13.06.17

Enclo:- As Stated.

Chief Engineer, MED

No. ME/ ***Dated***

Copy forwarded for information and necessary action to;-

1. *The Mayor, Siliguri Municipal Corporation.*

Chief Engineer, MED

[D:\Abhijit\NEW\saumya sir\Appraisal of DPR for SWM project within Siliguri MC.doc 1

GOVERNMENT OF WEST BENGAL
OFFICE OF THE CHIEF ENGINEER
Municipal Engineering Directorate

Bikash Bhawan, South Block (1st Floor), Salt Lake, Kolkata - 700 091.
Phone No: (033)2337-1581/(033)2358-[illegible] Fax: (033) 2357-5473
E-mail: ce_med@yahoo.com

No. ME/ 507 / 105 - 15/16 (Pt-VII) Dated 12.06.2017

From: The Chief Engineer,
Municipal Engineering Directorate

To: The Mayor
Siliguri Municipal Corporation

Sub: Detailed Project Report for Solid Waste Management for Siliguri Municipal Corporation

Sir,

A file has been received from the Director, SUDA on 24.05.2017 asking opinion regarding the DPR submitted from your end for SWM project within Siliguri Municipal Corporation.

While scrutiny it is found that the said DPR has already been checked by MoUD, GoI. But no appraisal note is found with the DPR.

Kindly let this office know about the appraisal status of the said DPR from MoUD(CBUD), GoI by submission of necessary documents to this office immediately for further processing of the matters.

Yours faithfully

Chief Engineer, MED

No. ME/ Dated

Copy forwarded for information to :

1. The Director, SUDA, II GUS Bhaban, H.C.Block, Sector-III, Salt Lake, Kolkata- 700 106.

Chief Engineer, MED

Subject: Fw: Reminder: Request for issue a letter on approval of Detailed Project Report for Municipal Solid Waste Management, Siliguri Municipal Corporation

From: Siliguri Municipal Corporation (smcwb@hotmail.com)

To: ce_medte@yahoo.com;

Date: Thursday, 8 June 2017 1:29 PM

From: g.vijaykumar@nic.in <g.vijaykumar@nic.in> on behalf of G VIJAY KUMAR <g.vijaykumar@nic.in>
Sent: Thursday, June 8, 2017 1:03 PM
To: Siliguri Municipal Corporation
Subject: Re: Reminder: Request for issue a letter on approval of Detailed Project Report for Municipal Solid Waste Management, Siliguri Municipal Corporation

Dear Siliguri City Representative,

This is to certify that the Detailed Project Report (DPR) on Solid Waste Management of Siliguri under Capacity Building for Urban Development (CBUD) project submitted by M/s IRG Systems South Asia Pvt. Ltd. has been approved by Ministry of Urban Development, Government of India.

With regards,
G Vijay Kumar
Under Secretary to the Government of India,
Ministry of Urban Development,
Smart Cities-III Division,
Nirman Bhavan, Room No. 202C,
New delhi-110001.
Ph. 01123063217
9682576758

On 06/08/17 11:49 AM, **Siliguri Municipal Corporation** <smcwb@hotmail.com> wrote:

> Sir,
>
> With reference to the earlier mail I am sending you again the request to kindly issue the approval letter of DPR on Solid Waste Managemenmt of Siliguri. Kindly treat this matter on urgent basis.
>
> Thanking You
>
> Joyeeta Dey
> Urban Planner
> Siliguri Municipal Corporation
> Mob. 9733889090
>
> ---
>
> **From:** Siliguri Municipal Corporation <smcwb@hotmail.com>
> **Sent:** Tuesday, June 6, 2017 2:00 PM
> **To:** g.vijaykumar@nic.in

Subject: Fw: Request for issue a letter on approval of Detailed Project Report for Municipal Solid Waste Management, Siliguri Municipal Corporation

Dear Sir,
As per our telephonic conversation I would like to send you this letter with a kind request to issue a letter on approval of Detailed Project Report for Municipal Solid Waste Management, Siliguri Municipal Corporation for our further reference. We have no such approval letter from Ministry. Kindly cooperate us in regard. Its urgent because State Urban Development Agency has sent that report to MED for fund approval. May be we shall get some fund. Kindly send.

Joyeeta Dey
Urban Planner
Siliguri Municipal Corporation
Mob. 9733889090

From: Siliguri Municipal Corporation <smcwb@hotmail.com>
Sent: Monday, February 13, 2017 1:25 PM
To: G VIJAY KUMAR
Subject: Request for issue a letter on approval of Detailed Project Report for Municipal Solid Waste Management, Siliguri Municipal Corporation

Sir,

Thank you for your earlier response. As per our telephonic conversation I would like to send you this letter with a kind request to issue a letter on
approval of Detailed Project Report for Municipal Solid Waste Management, Siliguri Municipal Corporation for our further reference. We have no such approval letter from Ministry. Kindly cooperate us in regard. Its urgent because tomorrow I shall submit the report to MAD, Govt. of West Bengal for release fund.

Thanking You

Joyeeta Dey
Urban Planner
SMC
Mob 0 733889090

GOVERNMENT OF WEST BENGAL
OFFICE OF THE CHIEF ENGINEER
Municipal Engineering Directorate

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Phone No: (033)2337-1331/ (033)2358-3347 \ Fax: (033) 2337-5472 /2337-5474
E-mail: ce_medte@yahoo.com

No. ME/ 855/10S-15/96 Pt-IX Dated 19-07-2018

From : The Chief Engineer
M. E. Dte.
Bikash Bhavan

To : The Director, SUDA
And Mission Director, SBM
ILGUS Bhaban, H.C.Block, Sector-III,
Salt Lake, Kolkata- 700 106.

State Urban Development Agency
Received
5308
20 JUL 2018
Contents not Verified

Sub: Re-Submission of Detailed Project Report of SWM under Swachh Bharat Mission within Midnapore Municipality (Phase I)

Sir,

In continuation previous memo no. ME/624/10S-15/1996 Pt. VIII dt. 22.03.2018 I am sending herewith again 2 (Two) nos. of the Detailed Project Report of SWM projects along with appraisal report for the town Midnapore (Project cost Rs. **1447.97 Lakh** without collection and transportation arrangement) under Swachh Bharat Mission for your kind perusal and taking necessary action please.

Yours faithfully,

19.7.18.

Chief Engineer, MED

Enclo : 1. Appraisal report
2. DPR in duplicate

GOVERNMENT OF WEST BENGAL
OFFICE OF THE CHIEF ENGINEER
Municipal Engineering Directorate

Bikash Bhawan, South Block (1st Floor) Salt Lake, Kolkata – 700091
Phone No: (033)2337-1331/ (033)2358-3347 \ Fax: (033) 2337-5472 /2337-5474
E-mail: ce_medte@yahoo.com

No. ME/ 624 / 105 – 15 / 1996 Pt-VIII Dated 22 / 03 / 2018

From : The Chief Engineer
M. E. Dte.
Bikash Bhavan

To : The Director, SUDA
And Mission Director, SBM
ILGUS Bhaban, H.C.Block, Sector-III,
Salt Lake, Kolkata- 700 106.

Sub: Submission of Detailed Project Report of SWM under Swachh Bharat Mission within Midnapore Municipality (Phase I)

Sir,

In reference to the above noted subject I am sending herewith 2 (Two) nos. of the Detailed Project Report of SWM projects along with appraisal report for the town Midnapore (Project cost Rs. **1447.97 Lakh** without collection and transportation arrangement) under Swachh Bharat Mission for your kind perusal and taking necessary action please.

Yours faithfully,

22.03.18.

Chief Engineer, MED

Enclo : 1. Appraisal report
2. DPR in duplicate

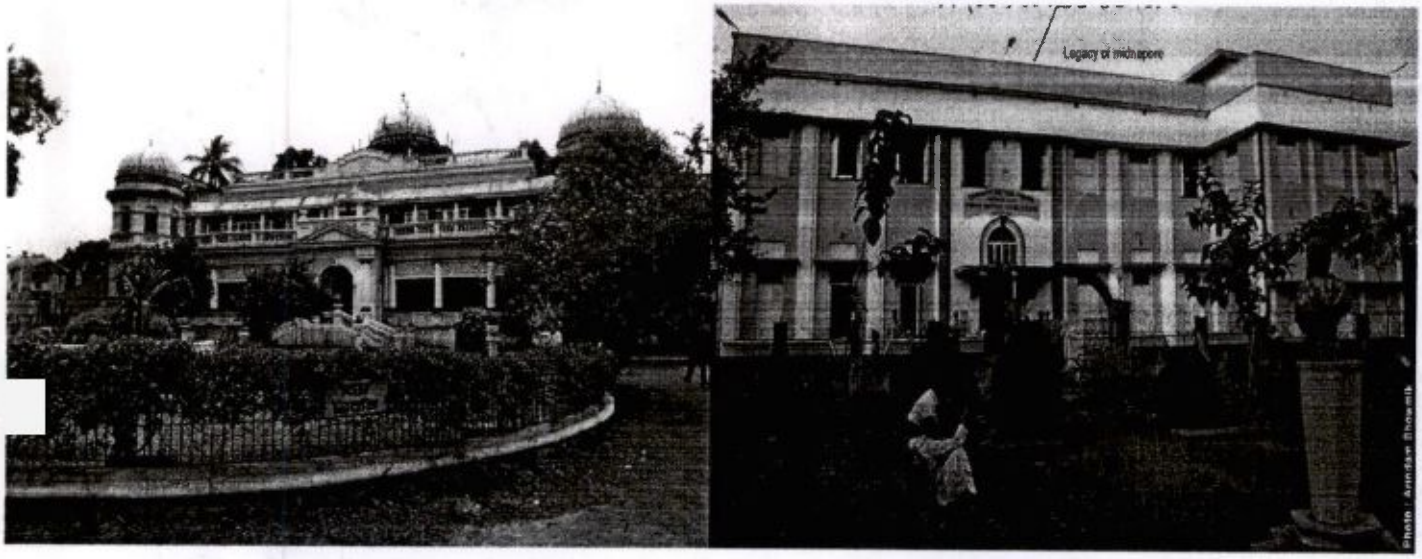
22 MAR 2018

DETAILED PROJECT REPORT

MIDNAPORE MUNICIPALITY

March 2018

DETAILED PROJECT REPORT



MIDNAPORE MUNICIPALITY

March 2018

APPRAISAL REPORT

1.	Name of the Project	Solid Waste Management Project under Midnapore Municipality (Phase I)			
2.	Sectoral area	Urban			
3.	Total Financial outlay	**1447.97 Lakh**			
4.	Financial arrangement				
Funds being made available by					*Total*
Implementing agency		*GoI Share*	*State Share*	*Others, if any(ULB share & Addl. State share)*	
Midnapore Municipality		506.79 Lakh	168.93 Lakh	772.25 Lakh	1447.97 lakh
5.	Project duration (dates/months/years)	24 Months			
6.	Location of project	Midnapore Municipality in Pachim Medinipore District, West Bengal			
7.	Previous phases, if any	No			
8.	Statutory required	Clearance/Permission from concerned authority such as State Environment Department, State Electricity Board, State Pollution Control Board (SPCB), Highways, PWD etc. (wherever applicable).			
9.	Statutory obtained	To be obtained after approval of the project by the ULB.			
10.	Details of Feasibility Studies done (if any)	The project is technically and financially feasible			
11.	Implementing agency	Midnapore Municipality with technical assistance from MED, Govt. of West Bengal			
12.	Basic design of the project				
i)	Goals and Objectives	The main objective is conversion of waste to energy (Electricity) through generation of bio-gas, preparation of manure and proper management of recyclables.			
ii)	Activities involved	Collection, transportation, separation and production of Electricity through bio-gas, manure and selling of recyclables, sanitary land filling for inert as per relevant manuals and guidelines of Govt. of India. However, cost estimate for collection and transportation arrangements are not considered in this DPR.			
iii)	Outputs of the project	Waste free city with minimum discharge to landfills.			
iv)	Outcome of the project	The day to day hazards of waste mechanism will be addressed with due importance to socio-economic view points, as well the municipal revenue infrastructure will be soundly built in a new form.			
13.	Target population				
i)	As per Census 2011	169127			
ii)	Base Year (2019)	192369			
iii)	Intermediate Year (2029)	224319			
iv)	Final Year (2039)	260053			
14.	Per capita expenditure proposed				
i)	Considering Census population 2011	Rs. 856.70			
ii)	Considering Base Year population (2019)	Rs. 752.14			
15.	Quantitative and qualitative (verifiable) target Indicators	As per CPHEEO Manual published by MoUD, Govt. of India			

16.	Environmental sustainability of the project	The project does not affect the green belt. No tree is required to be cut. No water body is affected by the proposed project. No natural outlays are also affected by the proposed project. There is no possibility of soil erosion.
17.	Land acquisition / Resettlement and Rehabilitation involved	Land already procured
18.	Operation and Maintenance	Midnapore Municipality
19.	Finance Plus Criteria	
(i)	Innovations and piloting of new approaches	Waste to energy (Electricity)
(ii)	Innovations in financing and leveraging	Surplus income will be generated after meeting Operation and Maintenance costs.
20.	Whether the project is recommended for Sanction or not (Y/N).	Yes
21.	If not, please mention reasons and area for improving DPR.	Not Applicable
22.	Estimated cost for consideration & approval (INR Lakh)	**Rs. 1447.97 Lakh**

22.03.17

Chief Engineer
Municipal Engineering Directorate
Govt. of West Bengal

Preface

The urban solid waste problems are growing exponentially in the cities and urban centers of this country. Inadequate and inappropriate solid waste management policy is imposing threats on the environment, polluting the natural resources which in turn endangers the eco-system by large. It has reached disastrous proportions nowadays. The problem has become critical further for the reasons of lower socio-economic structures, inadequate resources, lack of techno management initiatives and community participation as a whole. Coupled with budgetary restrictions, poorly motivated staff, inadequate vehicles and implements the solid waste management has become one of the burning problems of the local bodies. The existing infrastructure is barely adequate to cope up with today's need.

This detailed project report, "**Solid Waste Management System**" for the **Midnapore Municipality** has been prepared for improvement of the present solid waste management system of the town and also for proper surveillance and sustainability of the system. The report emphasizes upon the adequate steps for collection, transportation and processing through generation of energy & disposal of solid waste generated by the community. However in Phase I of the DPR Processing Plants and development of land fill site have been considered. **The project cost for this Phase I is Rs. 1447.97 lakh.** Machinery & equipments for collection, transportations and disposal will be considered in the Phase II of the DPR. The most vital component of this project is the procurement of land in the near vicinity of the town and Midnapore Municipality already has the land required in their possession. The project will be implemented and managed by Midnapore Municipality with the technical assistance and guidance of Municipal Engineering Directorate.

Hope, this project will not only improve the environmental condition of the town and the health of the community, as a whole but will also fetch a good amount of revenue from the project.

*Thus **waste to wealth.***

CONTENT

SWM : MIDNAPUR MUNICIPALITY (Phase - I)

PROJECT SUMMARY

POPULATION	:		169127	
AREA	:		13.25	SQ.KM
NO. OF HOLDINGS	:		28829	Nos.
NO. OF WARDS	:		25	Nos.
NO. OF DAILY MARKETS	:		18	Nos.
NO. OF COMMERCIAL CENTRES	:		14	Nos.
NO. OF HOTELS	:		33	Nos.
NO. OF HOSPITALS	:		5	Nos.
QUANTITY OF WASTE				
A) DOMESTIC WASTE	:		46.51	MT
B) MARKET WASTE	:		14.00	MT
C) HOTEL WASTE	:		0.18	MT
D) GARDEN/AGRICURTURAL WASTE	:		0.70	MT
D) TRADE WASTE	:		5.00	MT
E) OTHERS WASTE	:		8.00	MT
F) CLINICAL WASTE	:		1.20	MT
TOTAL QUANTITY OF WASTE	:		75.59	MT
PROJECT COST				
A) PLANT, MACHINERY, EQUIPMENTS FOR COLLECTION, TRANSPORTATIONS AND DISPOSAL	:	Rs.	0.00	TO BE CONSIDERED IN PHASE II
B) DEVELOPMENT OF LANDFILL SITE	:	Rs.	213.56	LAKH
C) CONSTRUCTION OF BIO-GAS PLANT	:	Rs.	1192.23	LAKH
D) CONTINGENCIES		Rs.	42.17	LAKH
TOTAL PROJECT COST	:	Rs.	1447.97	LAKH
PROJECT PERIOD	:		2	YEARS
O & M COST PER YEAR (FOR LAND FILLING & PROCESSING)	:		73.18	LAKH
LAND REQUIRED				
A) FOR SANITARY LANDFILL	:		2.2	ACRES
B) FOR BIOGAS PLANT AND OTHERS	:		1.2	ACRES
TOTAL LAND REQUIRED			3.4	ACRES
TOTAL LAND AVAILABLE	:		6.28	ACRES

Sub- Assistant Engineer
MIDNAPORE MUNICIPALITY

Chairman
Midnapore Municipality

INTRODUCTION

Solid Waste Management system involves activities associated with generation, collection, transfer & transport and processing and disposal of solid wastes generated by the community. It involves planning, organization, administration, finance, legal and engineering aspects involving interdisciplinary co-ordination. This aspect received scanty attention in most of the municipal towns resulting in insanitary conditions. An effective solid waste management scheme can be drawn by means of a harmonic integration between the available in house resources and the latest technologies.

Solid Waste Management is an obligatory function of Urban Local Bodies (ULBs) in India. However, this service is poorly performed resulting in problems of health, sanitation and environmental degradation. With over 3.6% annual growth in urban population and the rapid pace of urbanization, the situation is becoming more and more critical with the passage of time. Infrastructure development is not in a position to keep pace with population growth owing to the poor financial health of most of the urban local bodies. Solid Waste Management is one among the essential services, which suffers the most in such a situation. Lack of political will, inadequate financial resources, institutional weakness, improper choice of technology and public apathy towards Solid Waste Management has made this service far from satisfactory.

India has 4378 cities and towns as per 2001 census which comprises as under.

Type of cities/towns	Population range
Above 1 million	35
Above 1 lakh	358
Above 50000	401
Below 50000	3584
Total	4378

Waste generation ranges from 200 gms. to 600 gms per capita per day in cities ranging from I Lac to over 50 Lakh population. The larger the city, the higher is the per-capita waste generation rate. The total waste generation in urban areas in the country is estimated to exceed 100000 tons a day.

Indian mixed waste has a large proportion of compost able material and inerts. As per recent studies compost able matters are approximate 55% and inert materials 30 %. The component of recyclable material is between 15%.

A study of Indian cities has shown the Chemical Composition as under:

Sub- Assistant Engineer
MIDNAPORE MUNICIPALITY

Chairman
Midnapore Municipality

Chemical Characteristics of Municipal Solid Waste in Indian Cities

Population Range (in millions) ⟶	0.1 to 0.5	0.5 to 1.0	1.0 to 2.0	2.0 to 5.0	> 5
Physical Characteristics					
Paper (as %)	2.91	2.95	4.71	3.18	6.43
Rubber Leather And Synthetics (as %)	0.78	0.73	0.71	0.48	0.28
Glass (as %)	0.56	0.35	0.46	0.48	0.94
Metals (as %)	0.33	0.32	0.49	0.59	0.8
Total compostable matter (as %)	44.57	40.04	38.95	56.67	30.84
Inert (as %)	43.59	48.38	44.73	49.07	53.9
Chemical Characteristics					
Moisture (as %)	25.81	19.52	26.98	21.03	38.72
Organic matter (as %)	37.09	25.14	26.89	25.6	39.07
Nitrogen as Total Nitrogen (as %)	0.71	0.66	0.64	0.56	0.56
Phosphorous as P2O5(as %)	0.63	0.56	0.82	0.69	0.52
Potassium as K2O(as %)	0.83	0.69	0.72	0.78	0.52
C/N Ration	30.94	21.13	23.68	22.45	30.11
Calorific value* in Kcal/kg	1009.89	900.61	980.05	907.18	800.7

Source: Manual on Municipal Solid Waste Management 2000- CPHEEO
**Calorific Value on dry weight basis*

The prevalent SWM practices in the country are highly deficient. Generally no storage of waste is being done at source and instead, domestic, trade and institutional wastes, including bio-medical and industrial waste, are thrown on the streets, footpaths, drains and water bodies treating them as receptacle of waste. Recyclable waste material is also not segregated at source and is disposed of on the streets, along with domestic, trade and other wastes. Construction and demolition wastes also pose a serious problem as these wastes are also deposited on the roadside or open spaces, obstructing traffic and causing nuisance.

Generally no processing of waste is done in the country except in a few cities where decentralized or centralized composting is done on a limited scale. Here, the marketing of compost is posing a problem due to ineffective marketing mechanism. A few cities have recently attempted to set up waste to energy plant; their success is yet to be evaluated. Disposal of waste is done in a most unscientific manner. Generally crude open dumping is adopted for disposal of waste in low-lying areas. Most local bodies' deposits waste at the dump-yards without ascertaining the suitability of the land for waste disposal and do not bother to spread or cover the waste with inert material. These sites emanate foul smell, become breeding grounds for flies, rodent and pests, and pose a serious threat to underground water resources and overall environment. System of waste management in the country is thus out-dated, unscientific and highly inefficient.

Sub- Assistant Engineer
MIDNAPORE MUNICIPALITY

Chairman
Midnapore Municipality

The laws governing the urban local bodies do not have adequate provisions to deal with the situation effectively officials dealing with SWM service do not have the necessary powers to punish defaulters. Filling of cases in the court for sanitation offences is cumbersome, takes a lot of time and energy of the staff and does not give the desired results as the punishment imposed at the end of long drawn proceedings is too small to have any salutary effect on the offender.

Looking to the deplorable situation of solid waste management in the country, public interest litigation was filed in the Supreme Court of India seeking direction to central government, state governments and city governments to manage the waste scientifically in an environmentally acceptable manner. Having realized the gravity of the situation, the Hon'ble Supreme Court constituted an expert committee to look into all aspects of solid waste management and make recommendation to improve the situation in class-1 cities.

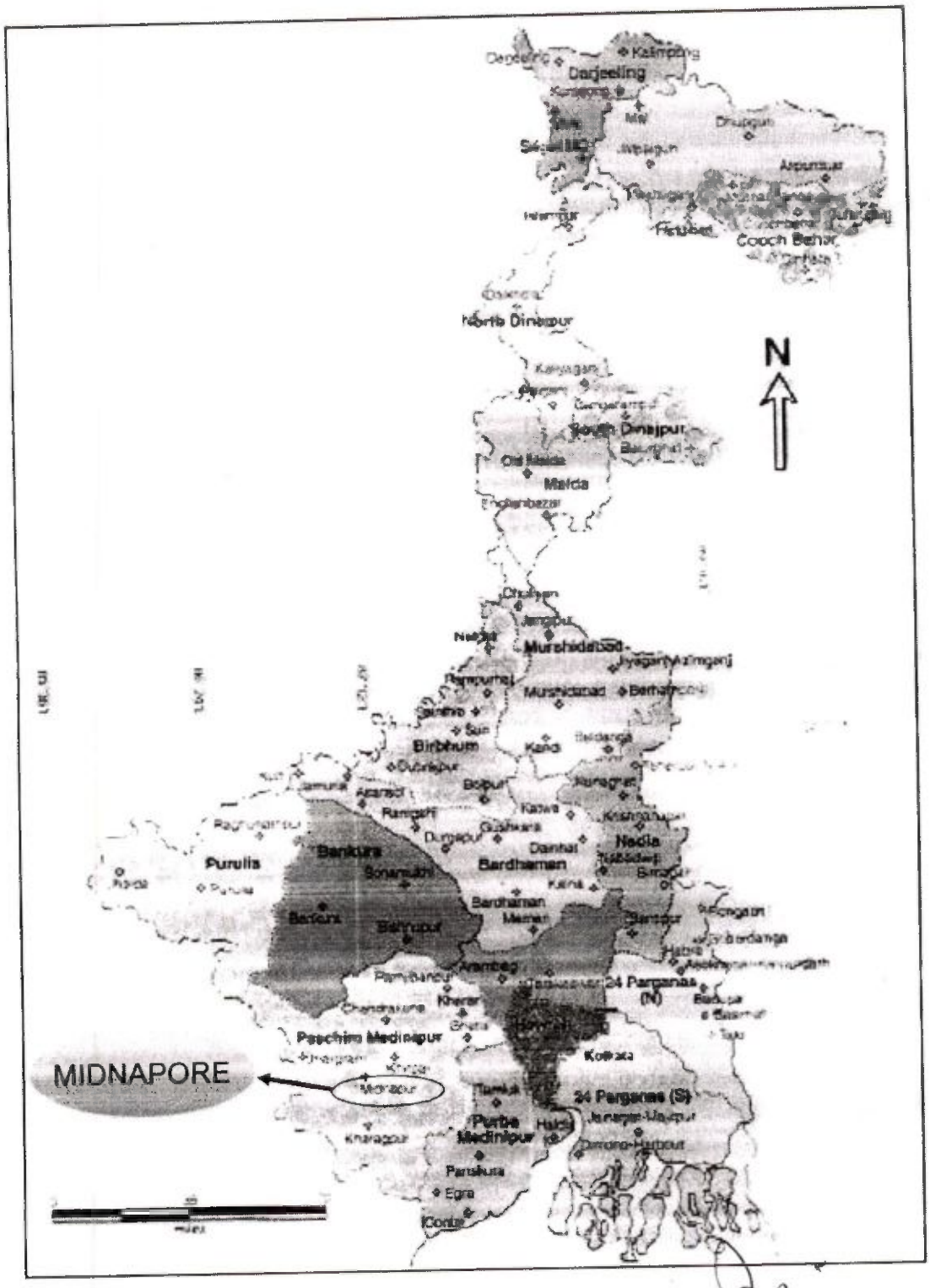
The Committee so formed considered various options to improve solid waste management practices in these cities and, looking to the present state of SWM practices in urban areas in the country, the institutional capabilities of local bodies, their financial health and other priorities, recommended a minimum level of services that each local body must provide and gave technological options which the local bodies may consider while choosing the technology suitable for their cities, etc.

This Project Report is for identification of deficiencies and giving suggestions for development of a comprehensive Solid Waste Management System in Midnapur Municipality as per the directives of Hon'ble Supreme Court and subsequent order No. 290/C-12/M/3S-1/97 Pt.V dated 6th January, 2005 of Department of Municipal Affairs, Govt. of West Bengal.

Sub- Assistant Engineer
MIDNAPORE MUNICIPALITY

Chairman
Midnapore Municipality

Map of West Bengal showing Non-KMA ULBs :



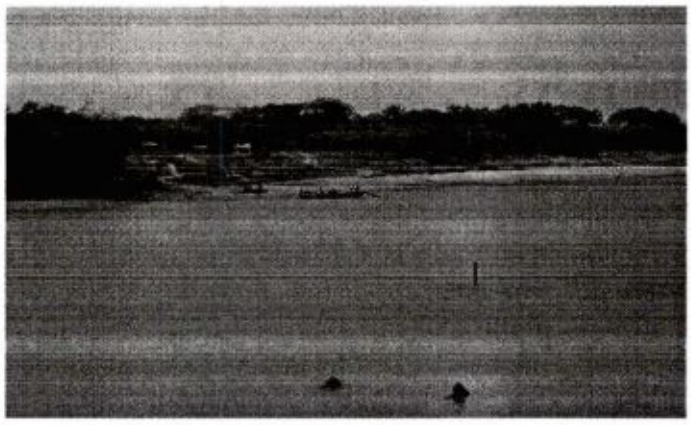
Sub- Assistant Engineer
MIDNAPORE MUNICIPALITY

Chairman
Midnapore Municipality

Overview of the Midnapore Town

Introduction

Midnapore (also written as Medinipur and Midnapur) is a town in West Bengal, India. The city is the headquarters of, and gives its name to, the Paschim Medinipur district of the state of West Bengal. The town also gives its name to a subdivision of the district. The town used to belong to the Midnapore District until the Partition of Midnapore. The Partition of Midnapore was the administrative breakup of the Midnapore District of West Bengal, India into the western part as Paschim Medinipur and the eastern part as Purba Medinipur districts that became effective on January 1, 2002. With the division of the district, the subdivisions of Medinipur Sadar, Kharagpur, Jhargram, and Ghatal were placed in Paschim Medinipur, with Midnapore, now the district headquarter of only the western half. The undivided Midnapore district had been, at one time, the largest district in West Bengal and indeed, all of India.



It is situated on the banks of the Kangsabati River (variously known as Kasai and Cossye). On the opposite bank of the river is the industrial and railway hub Kharagpur. The bank of Kangasabati River is great for sightseeing and fishing and a popular destination for picnics during the Christmas and New Year's breaks. Unfortunately the bank is being eroded by new construction, brick-kilns and new communities.

Origin of the name

There are conflicting accounts of how the name Medinipur came to be. One account claims that Medinipur was named after a local deity "Medinimata" (literally "mother of the world", a Shakti incarnation). Another account claims that Midnapur was so named because in the heyday the number of mosques rivalled those in Medina.

Historical Overview

A number of prehistoric sites of great interest are being excavated throughout the West Midnapore district. In ancient times the region seems to be highly influenced by Jainism and Buddhism. Coins issued by Samudragupta have been found in the near vicinity of the town. The kingdom of Shashanka and Harshavardhana included what is now Midnapore.

Midnapore is famous for its contribution in the history of Indian freedom movement since it has produced a seemingly endless list of martyrs. During the British Raj the town became a centre of revolutionary activities starting from the Santal Revolt (1766-1767) and the Chuar Revolt (1799). The Zilla School, now known as Midnapur Collegiate School was the birthplace of many extremist activities. Teachers like Hemchandra Kanungo inspired and guided the pupils to participate in the Indian Freedom Movement. Three British District Magistrates were assassinated in succession by the revolutionaries Benoy Basu, Dinesh Gupta, and Badal Gupta. Dalhousie Square, a major location in Kolkata is named B.B.D. Bagh in their honour. Khudiram Bose and Satyendranath Basu were some of the young men that laid down their lives for the freedom of India. Kazi Nazrul Islam attended political meetings in Midnapore in the 20s. Even Raja Narendra Lal Khan, ruler of Narajole,

Sub- Assistant Engineer
MIDNAPORE MUNICIPALITY

Chairman
Midnapore Municipality

who donated his palace on the outskirts of town, for the establishment of Midnapore's first college for women, had been implicated, (although it turned out to be false) for planting a bomb. Not only Hindu activists but Muslim statesman originated or spent time in Midnapore. Huseyn Shaheed Suhrawardy founder of the Awami League, a prominent political party in Bangladesh, and the sixth President of Pakistan hailed from a prominent family of Midnapore.

Climatic Condition

The climate follows a hot tropical monsoon weather pattern. Summers last from April to mid-June with diurnal highs ranging from the upper 30s°C to the mid 40s°C and lows in the low 30s°C. However extensive daily heat is often followed by evening rains known as kalboishakhis or dust-storms (loo). Monsoon rains can last from mid-June to late August or even September with rains from the southeast monsoon typically contributing the lions-share of the annual rainfall of around 1500 mm. Winters last for 2 to 3 months and are mild; typical lows are from 8 °C - 14 °C.

Geography

Midnapore is 23 metres above sea-level. Soils near the Kangsabati River are alluvial with a high-degree of clay or sand depending on the locality; whereas soils towards Rangamati are essentially lateritic. Vegetation is essentially same of that common to South Bengal with extensive eucalyptus and Sal forests on Northwest side of town. In fact the sal forests form part of the Dalma Bengal-Jharkhand Range. Arabari, the forest range which was the site of India's first Joint Forest Management scheme is only 30 km away. The Midnapore town covers an area of 18.36 sq. kms. surrounded by the Cassai river on the south, Panchkuni 1 and Panchkuni 2 G.P. on the west, Siromoni G.P. on the north and Kankabati G.P. on the east.

Transport

Midnapore is well connected not only to larger cities in the region, but also to smaller towns and villages in the district. Midnapore Railway Station is on the Howrah-Adra and Howrah-Purulia Expres Train routes. Many major express trains pass through Midnapore including the Delhi-Puri Nilachal Express. In addition, there are a number of local trains that ply between Howrah and Midnapore with amazing regularity. The proximity to Kharagpur, a major hub of the Indian South-Eastern Railway system, only 30 minutes or less by train, makes Midnapore well connected with the major cities of India. A bus terminus (Central Bus Stand) serves the greater Midnapore area. Many buses ply to smaller towns in the districts of Midnapore West, Midnapore East, Burdwan, Bankura, and Purulia in West Bengal, to districts of Jharkhand and Mayurbhanj and Baleswar in Orisa.

Infrastructure

Electricity is readily available, although as in the rest of West Bengal, demand truly exceeds supply. Times of Power outage are common especially in the summer and monsoon months, although outages lasting more than an hour are increasingly becoming rarer.

Water is a scarce resource in Midnapore town. Most of the water comes from the Kasai river which is shrinking in size every year due to over-exploitation. The shallow water levels have also receded to lower levels. Although the Midnapore Municipality freely provides water, it is planning to impose water tax scheme for the users.

Sewage disposal is another source of concern. Many of the lower income-communities in the town do not have adequate plumbing and must rely on refuse-collectors to haul out human waste. Not all drains are covered either, thus causing a proliferation of disease causing flies and mosquitoes. However, since Midnapore is drier than many other coastal and humid low-lying towns of West Bengal, this problem is not as acute.

There are around 1 lakh vehicles including Two Wheelers, Wheelers (Private & Transport), Bus, Trucks etc. in Midnapore. The Motor Vehicles Section (Regional Transport Office) is one of the important section of the District Administration which is mostly involved in providing the services to the public and is also responsible for collecting revenue for the Government. The host based computer system UNIX SVR 4.2 O.S. and Oracle 6.0 RDBMS were installed here in 1996 by

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NIC Midnapore. Since then, online transaction has been made operational to facilitate the people. Registration of Vehicles (Transport & Private), Tax Collections, CF upgradations, National Permit, Issue of Blue Book, Miscellaneous Receipt etc. of the Regional Transport office are done through online operation.

Various other sectors are being explored where it is feasible to use Information Technology for a better Citizen Government interface in future. Moreover, DRDA, Midnapore is one of the 15 pilot DRDAs for the implementation of RURAL SOFT - 2000 selected by the Ministry of Rural Development, Govt. of India.

Demographics

As of 2011 India census, Medinipur had a population of 1,69,127 out of which male population is 85360 and female population is 83,767.This makes it the second largest town in Paschim Medinipur district after Kharagpur. The town is almost equally divided in terms of population between Hindus and Muslims. A witness to the diversity of faith is multiple mosques and temples, many predating British rule. It is an important religious spot for the Muslims of India and Bangladesh. Even though the interesting religious mixture would suggest religions tensions, remarkably Midnapore has never witnessed major Hindu-Muslim communal tensions in recent history.

Governance

Midnapore is a municipality with 24 wards and 94,738 registered voters (2003 statistics). Midnapore elects one person to the West Bengal Vidhan Sabha and one representative to the Lok Sabha of the Parliament of India.

At a glance

Name of the Urban Local Body: Midnapore Municipality

1	Name of the District :	Paschim Medinipur
2	Year of establishment :	1865
3	Area (in sq. Km) :	18.36 sq. km
4	No. of wards :	25
5	Distance from District Headquarter :	District Headquarter
6	Population (census 2011) :	1,69,127
6.1	Male	85,362
6.2	Female	83,765
7	Density of Population (Per sq. km.) :	9211.7
8	Break up of Population (2011) :	
8.1	Scheduled Caste	15039
8.2	Scheduled Tribe	4192
8.3	Minorities	
9	Number of BPL Household (as per SUDA Survey) :	13389
10	Scenario of Slum :	
10.1	Total No. of Slum	156
10.2	Total Slum Population (as per USHA survey)	46,735
10.3	Percentage of Slum Population to the total population	27.63%
10.4	No. of Slum where Slum Infrastructure Improvement sanctioned under BSUP/ IHSDP	85

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10.5	No. of Slum where Slum Infrastructure Improvement already done under BSUP/ IHSDP-	68
11	Housing status for Urban Poor :(as on 31.03.2014)	
11.1	No. of dwelling units targeted to be provided under BSUP/ IHSDP	948
11.2	No. of beneficiaries already provided with Houses under BSUP/ IHSDP	945
11.3	No. of beneficiaries provided with Houses under " Housing for Urban Poor "	12 new+ 112 upgradation
12	Road :	
12.1	Length of Metalled Road (in km.)	256.77
12.2	Length of Non-Metalled Road (in km.)	115.75
12.3	Length of other Roads (in km.)	
12.4	Total length of Road (in km.)	372.52
12.5	Total no. of wards fully covered with Metal / Cement Concrete Road	3
13	Drainage :	
13.1	Length of Kutcha Drain (in km.)	375.00
13.2	Length of Pucca Drain (in km.)	265.00
13.3	Length of underground / covered Drain (in km.)	0.60
13.4	Total length of Drain (in km.)	640.60
13.5	No. of wards fully covered with Pucca Drain	Nil
13.6	No. of wards partly covered with Pucca Drain	25
14	Water Supply : -	
14.1	No. of Water Treatment Plant	Nil
14.2	No. of Deep Tube well	92
14.3	No. of Hand Tube well	448
14.4	No. of Street Stand post	4580
14.5	Length of Water pipeline (in kilometer)	558.86
14.6	No. of Underground Reservoir	6
14.7	No. of Overhead Reservoir	5
14.8	No. of wards fully covered with water supply pipeline	Nil
14.9	No. of houses connected with Water Supply Network	11,047
14.1	Who is maintaining water supply – Municipality / PHE Dept./ KMDA / KMWSA	Municipality
15	Sewerage and Sanitation :	
15.1	No. of sanitary latrine constructed	3552
15.2	No. of family provided with Sanitary Latrine under ILCS + BSUP / IHSDP+ HUP (together)	3552
15.3	No. of Community Latrine /Public Toilet	59
15.4	Length of Sewer Line (in kilometer)	Nil
15.5	No. of Sewage Treatment Plant (STP)	Nil
16	Solid Waste Management :	
16.1	No. of Dumping Ground, if any	1no,6.38 acre
16.2	No. of Landfill site , if any	Nil
16.3	No of Mechanical Sweeper, if any	One excavator
16.4	No. of Compactors, if any	Nil
17	Street Light :	

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17.1	No. of Light Post	5700
17.2	No. of High Mast Light Post +Low Mast	4+40
17.3	No. of Trident Light Post	137
17.4	No. of other Ornamental Light Post	8
17.5	No. of Wards covered with light posts	25
18	Health :	
18.1	No. of Hospital (ULB + Govt. + Others)	3 Govt.
18.2	No. of Municipal Maternity Home	Nil
18.3	No. of Regional Diagnostic Centre	>60
18.4	No. of Extended Specialist Out Patient Department (ESOPD) (IPP-VIII)	Nil
18.5	No. of Municipal Health Sub-Centre	8
18.6	No. of Municipal Health Administrative Unit (HAU)(IPP-VIII)	Nil
18.7	No. of Municipal Dispensaries	1
18.8	No. of Municipal Ambulances	1
18.9	No. of Hearse Car	1
19	Education :	
19.1	No. of Higher Secondary School (Municipal)	Nil
19.2	No. of Higher Secondary School (others)	25
19.3	No. of Secondary School (Municipal)	Nil
19.4	No. of Secondary School (others)	2
19.5	No. of Primary School (Municipal)	Nil
19.6	No. of Primary School (others)	87
19.7	No. of Sishu Siksha Kendras (SSK)	15
19.8	No. of ICDS Centre	102
19.9	No. of Junior High School	Nil
20	Other Infrastructure :	
20.1	Bridge	15
20.2	Flyover	1
20.3	Stadium	1
20.4	Parks	16
20.5	Playground	8
20.6	Auditorium/Community Hall	2
20.7	Borough Office	Nil
20.8	Ward office	25 (not municipal owned)
20.9	ULB Market	7
20.10	Burning Ghat	1
20.11	Electric Crematorium	1
20.12	Burial Ground	5
20.13	Public Library	2
20.14	Bus Terminus	1
20.15	Ferry Ghat	Nil
20.16	Guest House/ Tourist Lodge	2
20.17	Road Roller	1
20.18	Cess Pool	1
20.19	No. of Slaughter House:	3

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20.19.1	Municipal Slaughter House	
20.19.2	Other Slaughter House	3
20.20	Others (Please specify)	
21	Community Structure under SJSRY : -	
21.1	Total No. of CDS -	4
21.2	Total No. of NHC -	29
21.3	Total No. of NHG -	430
21.4	No. of Thrift & Credit Group (TCG)-	370
21.5	No. of SHG-	Nil
21.6	No. of DWCUA formed -	nil
22	National Social Assistance Programme (NSAP) : -	
22.1	No. of beneficiaries under Indira Gandhi National Old Age Pension Scheme (IGNOAPS) -	3006
22.2	No. of beneficiaries under Indira Gandhi National Widow Pension Scheme (IGNWPS) -	2987
22.3	No. of beneficiaries under Indira Gandhi National Disability Pension Scheme (IGNDPS) -	242
22.4	No. of beneficiaries under National Family Benefit Scheme (NFBS) -	144
23	No. of Annapurna Antodaya Yojana (AY) card holder :	16110
24	No. of Annapurna Anno Yojana (AAY) card holder : -	138
25	No. of beneficiaries under Janani Suraksha Yojana (JSY) : -	1
26	No. of beneficiaries under KANYASHREE scheme: -	3869
27	No. of beneficiaries under YUBASHREE scheme: -	1128

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1.0 PRESENT SCENARIO OF SOLID WASTE MANAGEMENT SYSTEM IN WEST BENGAL

1.1 SOLID WASTE MANAGEMENT SYSTEM

The state of West Bengal witnessed significantly high level of Urbanization during the decades of seventies and eighties. The urban population in West Bengal was estimated as 27.39% of the total population in the 1991 census report as against 25.70% for the entire country. In terms of density of urban population, West Bengal is much ahead of other states. The over all density of urban population in West Bengal in 1990-91 was estimated as 6207 individuals per square kilometer against the national average of 4098.

While the urban towns in West Bengal have rapidly increased in terms of activities and population, the municipal services available at these urban centers are yet to reach the adequate level. Solid wastes in the urban areas are generated from a multitude of sources out of domestic, commercial, institutional & industrial activities. If these wastes are not stored, collected, hauled and disposed off safely and timely, the same cause aesthetic problems and severe impact upon the public health, by means of pollution of air, soil and natural water sources. Therefore Solid Waste Management (SWM) is one of the crucial civic services, without which no pollution abatement measure can be full proof and sufficient. Although SWM is the single largest item of expenditure in the municipal budge, this service suffers from critical deficiencies.

In the wake of fast growing environmental consciousness and increasing public health problems, the concern in respect of inefficient SWM has metamorphosed into an alarming situation, which has inspired the urban local bodies to look for appropriate cost effective technology along with fiscal support.

The different components of the SWM for a particular town can be designed in a no. of ways depending on local conditions e.g. climate, waste characteristics, urban structure, transport economics and desired level of services.

1.2 EXISTING INFRASTRUCTURE & DEFICIENCIES

At present there is no National or State Plan for an integrated approach to deal with the Solid Waste Management System. In the matter of financial resources, the small and medium municipalities are much weaker / compared to the bigger municipalities. The bigger municipalities employ 5 staff per 1000 population, whereas the small and medium municipalities can hereby employ 2 to 3 staff per 1000 population.

1.3 SOLID WASTE CHARACTERISTICS

Community produces variety of wastes ranging from metal to textile produces and from ash to vegetable produces which have different physical and chemical composition. Apart from that, industrial and medical wastes used to get mixed up with municipal wastes frequently, which are usually disposed off indiscriminately without any special treatments.

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The average properties of solid waste based upon past studies may be predicted as per following :

Table-1

Character	Contents		Percentage
Physical :			
(i)	Earth & Ash Content	:	48%
(ii)	Fermentable	:	37%
(iii)	Stones & non-degradables	:	12%
(iv)	Density	:	560 to 600 kg/cu.m.
(v)	Calorific value	:	800 to 980 kcal/kg.
Chemical :			
(i)	Moisture	:	45%
(ii)	P^{H} value	:	6.80
(iii)	Nitrogen	:	0.5%
(iv)	Phosphorus	:	0.52%
(v)	Potassium	:	0.50%
(vi)	Organic matters	:	38%
(vii)	Carbon	:	20%
(viii)	C / N ratio	:	40

1.4 QUANTUM OF SOLID WASTE

The quantum of Waste generation depends upon the size of the town as well as its, socio-economic conditions. However, it was estimated that the generation of solid waste range from 200 to 600 gms. per capita per day depending upon the category, size and nature of activities in the town.

1.5 STORAGE AND COLLECTION

1.5.1 Existing Solid Waste Management

At present the refuse in municipal areas is disposed by uncontrolled dumping at places wherever low land is available. Landfill sites do not conform to any long term regional land use planning. Garbage removal is done only on intervals and there are always some accumulation of garbage on road side. Operational control for environmental protection and control of fly breeding is inadequate. Covering and compaction are not practiced.

1.5.2 Primary Collection

Primary collection starts at the household or at the community facilities. In all the municipal towns under consideration, house collection is almost non-existent and community facilities are scarcely provided. Practically none of the municipal bodies collects solid waste regularly from all areas except from market areas. The existing methods of garbage collection consists of following operation: i) Street sweeping, ii) Collection of road side garbage heaps and sweeping into box type hand carts or wheel barrows, iii) unloading the hand carts into bigger garbage vats or into bigger heap sites on main road.

1.5.3 Secondary Collection & Transfer

This particular activity in solid waste handling in municipal bodies involve picking up manually from the dumps of solid waste and loading into conservancy trucks / trailers. This results in wastage of labour and

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time for vehicles apart from the health risks of the workers and public at large, which are also exposed to danger of contamination of ground water, which is the main source of drinking water in most of the municipal bodies. In some small and medium towns, tractor-trailer system is being used extensively for transportation and in some small towns animal carts are also employed.

In most cases, the design of transportation vehicle is not appropriate and also not conducive to labour and vehicle productivity. The trucks which are used for transportation of the garbage to the dumping ground are found to be very inconvenient because (i) Excessive loading height of the trucks making manual loading difficult, (ii) they can not carry more than 3-4 tons of garbage due to its low density and high bulkage (iii) Excessive wear and tear of the body due to corrosive nature of the garbage (iv) Idle time lost in loading of the trucks.

1.6 DISPOSAL

More than 90% collected solid wastes in most of the municipal towns are disposed by filling up low lands scattered within the municipal areas in an uncontrolled, haphazard and insanitary manner which is a potential health risk for the community. Orthodox type composting in few towns is also practiced.

1.7 DEFICIENCIES AND SHORT COMINGS IN THE PRESENT SYSTEM

The overall picture of solid waste management in the municipal towns is not quite satisfactory and needs to be improved in order to achieve proper environmental sanitation. The basic short-comings and problems associated with solid waste management in municipal towns are as follow :

1. Population explosion, uncontrolled urbanization, slum area proliferation.
2. Socio-economic crisis (huge external debt, economic austerities, prolonged recession, high rate of inflation, high rate unemployment, social disorder, etc.)
3. Accelerated and uncontrolled generation of municipal wastes and industrial hazardous wastes.
4. Negligence and lack of interest for an effective solid waste management plan.
5. Insufficient public education and limited community participation.
6. In appropriate design of primary handcarts and collection vehicles causing multiple handling of waste and environmental problems.
7. The small and medium municipalities are lacking considerably in the servicing and workshop facilities for the mechanical transport fleet.
8. The location of disposal grounds and their sizes are not decided on the basis of optimum haulage and rotational transportation routing.
9. Disposal of solid waste by land filling method is not generally carried out in a proper sanitary method.
10. Regular analysis and monitoring of solid waste characteristics are not done and presence of toxic and hazardous materials cannot be ruled out.

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2.0 RECOMMENDATIONS OF THE SUPREME COURT APPOINTED COMMITTEE FOR MODERNIZATION OF SOLID WASTE MANAGEMENT PRACTICES ARE BRIEFLY AS UNDER

☆ Ban on Throwing of Wastes on the Streets

No waste shall be thrown on the streets, footpaths, open spaces, open drains or water bodies.

☆ Storage of waste at source

Waste shall be stored at source of generation in 2 bins/bags, one for food/bio-degradable wastes and another for recyclable waste. Domestic hazardous waste, as and when produced, shall be kept separately from the above two streams.

Multi storied buildings, commercial complexes and group housing shall additionally provide community bins for storage of waste generated by their members. Community bins shall also be provided in slums by the local body for the community storage of waste by slum dwellers.

☆ Doorstep Collection of Waste

Both the streams of waste, organic/ bio-degradable waste as well as recyclable waste shall be collected from the doorstep. Containerized handcarts or containerized tri-wheel cart or small-motorized vehicles shall be used for daily collection of food/ bio-degradable waste from the doorstep through public participation using a bell, whistle or horn as a means of announcing the arrival of the collection staff.

For collection of recyclable waste from the doorstep NGOs may be encouraged to organize the rag pickers. They may allot them the work of collection of recyclable material from the doorsteps instead of picking it up from the streets, bins or dump-yard, thereby upgrading their status. This waste can be collected once or twice a week according to the convenience of the households, shops or establishments.

Hazardous toxic waste material, which is occasionally generated, shall however be disposed of by the citizens in special bins to be provided in the city at suitable locations by the urban local bodies.

☆ Sweeping of Streets on All Days of the Year

Sweeping of streets and public places having habitation or commercial activities on one or both sides shall be done on all days of the year irrespective of Sundays and public holidays. Arrangements for rotating weekly rest-days are to be made by the local bodies.

☆ Work Norms for Sweeping of Streets

Work norms ranging from 250 to 750 running meters of road length have been recommended, depending on the density of the area and local conditions. Giving a demarcated "pin point" area for street sweeping and waste collection is also recommended for optimum utilization of manpower.

☆ Provision of Litterbins at Public Places

Provision of litterbins at railway stations, bus stations, market places, parks, gardens and important commercial streets may be made, to prevent littering of streets.

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☆ **Abolition of Open Waste Storage Sites and other Un-hygienic Street Bins**

The pathetic condition of street bins must be corrected by the provision of neat mobile closed body containers into which waste can be directly transferred from the containerized hand carts or tri-wheel cart and all open waste-storage sites as well as cement concrete or masonry bins must be abolished in a phased manner.

☆ **Transportation of Waste to Synchronize with Waste Storage Facility - Dispense with Manual Loading of Waste**

For the transportation of waste, a system which synchronizes with both primary collection and bulk waste storage facilities may be introduced. Manual loading and multiple handling of waste may be dispensed with and instead, hydraulic vehicles for lifting the containers may be used in larger cities and tractor trolleys or a tractor container combination may be used in smaller cities.

Transportation of waste shall be done on a regular basis before the temporary waste-storage containers start over-flowing. For economy in expenditure, the vehicle fleet should be used in at least two shifts. Workshop facilities may be optimized to keep at least 80% of the vehicle fleet on road. Transfer stations may be set up in cities where the distance to waste-disposal sites is more than 10 Kms.

☆ **Processing And Disposal Of Waste:**
Conversion of Organic Waste / Bio-degradable Waste into Bio-organic Fertilizer (Compost)

With the availability of land for processing and disposal of waste becoming scarce and the food and bio-degradable component useful to agriculture going waste, measures for conservation of land and organic waste resource shall be taken and Organics shall be returned to the soil. To meet these objectives, all food waste and bio degradable waste shall be composted, recyclable waste shall be passed on to the recycling industry and only rejects shall be land filled in a scientific manner. Decentralized composting with public and NGOs/CBO participation, may be encouraged wherever possible, and centralized composting of the rest of the waste may be done. Microbial or vermi composting processes may be adopted. A variety of composting options has been given in the report and their processes are explained.

☆ **Caution Against Using Unproven Technologies**

Local bodies are cautioned not to adopt expensive technologies of power generation, fuel polarization, incineration etc. until they are proven under Indian conditions and the Government of India or expert agencies nominated by the Government of India advises cities that such technology can be adopted.

☆ **Land To Be Made Available On Priority For Processing And Disposal Of Waste**

Availability of land for setting up processing plants and for disposal of waste is a major problem faced by urban local bodies. Government wasteland must therefore be given on top priority for this purpose free or at nominal cost, and if such land is not available or not found suitable, private land should be acquired or

purchased through negotiated settlement. A Committee at the district level should identify suitable land and State Governments should form Empowered Committees to give speedy final clearance and prompt possession of suitable land to the ULB.

☆ Criteria for Site Selection, Site Development and Landfill Operations

Criteria for site selection, development of land fill sites and scientific landfill operations may be adopted. Remediation of old abandoned landfill sites should also be done as suggested in the detailed report. Bio-medical waste, industrial waste and slaughterhouse waste may be managed as per the relevant Rules and guidelines of the Government of India and/or Central Pollution Control Board.

☆ Institutional Strengthening and Capacity Building

Institutional strengthening is the key to success of the SWM system. Professionalism in administration, decentralization of administration, delegation of financial and administrative powers, induction of environmental/public health engineers in the solid waste management services and fixation of work norms and proper supervisory levels are recommended. Human resource development through training at various levels needs to be taken up.

☆ NGO/Private sector Participation in SWM Services

There is a need to improve accountability and the level of services through NGO/Private sector participation in SWM services to improve overall performance without harming the interests of the existing staff.

☆ Enforcement

A system of levy of administrative charges or special cleaning charges from those who litter the streets or cause nuisance on the streets may be introduced and powers to punish offenders may be given to the local bodies through suitable additions to the Municipal acts & rules.

☆ Management Information System

MIS is the key to monitoring the performance of manpower and machinery and to help in planning for the future. Detailed management information systems should be introduced.

☆ Financial Aspects

The poor financial health of ULBs is major constraint in improving SWM systems. The financial condition of local bodies may first be improved by setting the house in order and a series of measures towards financial discipline, avoidance of wasteful expenditure, prioritizing the expenditure on essential services, as recommended in the report may be taken. Taxes, user charges and fees should be raised and linked to the cost-of-living index. Area-based property-tax reforms may be taken up to improve the finances of the ULBs.

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☆ Health Aspects

Improper SWM practices give rise to problems of health and sanitation. Twenty-two types of diseases are associated with improper SWM practices. Proper management of processing and disposal sites, special attention to cleaning of slums, provision of low cost sanitation facilities to prevent open defecation, prevention of cattle nuisance, proper training to the workforce and use of protective clothing are some of the measures the local body should take immediately to protect the health of the citizens and the work force.

☆ Legal Aspects

Citizens' active participation may be ensured through massive public awareness campaigns. Simultaneously, adequate provisions may be made in local State laws governing the local bodies to ensure public participation and action against defaulters. Legislative provisions to be made by each State have been suggested in the report.

☆ Public Awareness Strategy

Public awareness campaign using information, education and communication (I-E-C) techniques may be used. Waste Reduction, Reuse, Recycling (R-R-R) may be advocated to reduce the burden on the local body and citizens may be motivated to store waste at source in a two-bin system, co-operate with the doorstep primary collection system and keep the city litter-free. Hygienic Solid Waste Management needs to find a place in the National Agenda.

☆ NGO, Public and Private Sector Participation.

Supreme court committee has laid emphasize on active involvement of non-governmental organizations (NGOs) in creating awareness among the people, in organizing the rag pickers for collection of recyclable material and in organizing door step collection from households, shops and establishments.

A lot of emphasizes is to be given on public participation, without which no system would ever succeed. Public participation in the area of storage of waste at source, & at the community level and in the primary collection of waste is highly advocated and insisted upon. Legal provisions are also suggested to take action against the citizens if they fail to comply in spite of repeated instructions through awareness campaign to cooperate in the system.

Private sector participation is the key to success in the areas where higher technologies are involved and where personalized services are proposed to be given. With ever increasing cost of manpower and relatively lower efficiencies of public sector undertakings, it has been strongly recommended that private sector should be involved in the area of door step collection of waste ***from hospitals, nursing homes, hotels, restaurants, commercial complexes, households, etc. as well as in the area of transportation of waste and setting up solid waste treatment and disposal facilities in the urban areas.***

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2.1 ISSUES TO BE ADDRESSED

The following issues need to be addressed during policy formulations.

i) **Effective public participation in segregation of recyclable waste and storage of waste at source.**
ii) Public participation in primary collection of waste
iii) Sweeping of streets and primary collection of waste on all the days of the year irrespective of Sundays and public holidays.
iv) Provision of closed body mobile waste storage depots and abolition of open waste storage sites.
v) Safe and separate storage as well as doorstep collection of biomedical waste, hotel and restaurant waste, yard waste, etc., on full cost recovery basis.
vi) Avoid the need of multiple handling of waste through the adoption of principal of "handle waste once only" in the matter of collection, transportation and disposal of waste.
vii) Transportation of waste on day to day basis in closed body vehicles.
viii) Processing of waste for generating biogas, power and other useful products.
ix) Disposal of waste in an environmentally acceptable manner through establishment of sanitary landfill sites.
x) Grant of land for processing and disposal of waste.
xi) Institutional strengthening and human resources development.
xii) Institutional strengthening and human resources development.
xiii) Introducing element of cost recovery.
xiv) Encouraging private sector participation in waste management
xv) Welfare of the staff engaged in solid waste management services.
xvi) Creation of public grievances redressal mechanism.
xvii) Provision for enforcement of sanitation laws and rules.

2.2 SCOPE OF THIS REPORT

This report will deal with Solid Waste Management System of the town **Midnapur** in the district of West Midnapur of West Bengal. The objective of this report is to analyze the present situation and recommend for **"Planning and Development of Modernized Practices for Sustainable Solid Waste Management System in the Midnapur Municipality of West Bengal"**

The following chapters will discuss about the appropriate technology and methodology for handling, collection, transportation, processing & final disposal of municipal solid waste and also design a comprehensive Solid Waste Management System for Midnapur Municipality. The necessary recommendations and directions are also furnished below.

This project report is prepared by Municipal Engineering Directorate, Govt. of W.B., as per the request of Municipal Authority for compliance of Govt. order.

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3.0 COLLECTION OF WASTE

3.1 DEVELOPMENT OF POLICIES AND CHOICE OF APPROPRIATE TECHNOLOGY AND METHODOLOGY

The success of any solid waste management system largely depends upon the three factors (i) Collection, (ii) Transportation & iii) Disposal. So, to make success clear assessment on the quantity of solid waste to be handled is very much essential. In respect of Midnapur town a figure of 275 gm/cap/day is fairly reasonable for consideration. The verity of solid waste generally generate in a Municipal town are domestic, market, trade, Hospital / Clinical Waste in nature. Waste from street sweepings, sewer line cleanings and construction debris etc. also get into the access with the main waste.

With a view to improve upon the present collection, transport and disposal methods in the Municipality, future solid waste management works are to be carried out on the basis of the principles stated below.

Cost of transportation is one of the major components of solid waste management system. Routing and scheduling of vehicles are of prime important from economic point of view. For convenience and economic consideration of as collection and transportation of solid waste the whole Midnapur municipal area may be divided in zones.

3.1.1 Collection

The local body shall be the responsible for the arrangement for the collection of waste stored at various sources of waste generation on a daily basis. This shall be done by any of the following methods or combination of more than one method:

i) The garbage is to be suggested to be separated in accordance with their classes at the point of generation. This practice will help to dispose off the garbage effectively at the dumping ground, as well as reduction of massive handling activities of the cumulated garbage mass at a centralized point.

ii) The garbage is suggested to be containerized at the point of generation. This will not only help to reduce the collection time but will also reduce the health hazards. Therefore the service level will be better.

iii) Door-step collection of domestic waste through handcarts or similar other devices with active community participation.

iv) Collection through community bins from private societies multi storied buildings, markets, commercial and Office complexes etc.

v) Door-step collection of waste from authorized / unauthorized slums or collection from the community bins to be provided in the slums by the local bodies.

vi) Door-step collection of waste from posh residential areas on full-cost-recovery basis.

3.1.2 People's Participation in Collection:

Success of the effective solid waste management particularly primary collection system largely depends on the proper co-ordination between people who are the generator and the staff who are the collector.

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The average municipal solid waste characteristics depict high moisture content, with a relatively high density. Conventional metal bins and dumpers are found to be deteriorating within a short period due to the corrosive action of the waste mass. Hence, an appropriate design of the primary collection bins, with the help of modern technology is of prime necessity in order to reduce the recurring capital as well as maintenance costs.

3.2 MODUS OPERANDI

3.2.1 Door-step collection through containerized handcarts with bells / whistles

For domestic waste collection each collector may be given a tyre-mounted wheel barrow having eight detachable 20 litres containers and provided with a bell or whistle. Each collector shall be given a fixed area or beat for sweeping plus a fixed number or stretch of houses from which to collect the domestic waste. In congested or thickly populated areas, 300 running meters of road length and the adjoining houses may be given to each sweeper, whereas in less congested areas 500 running meters of the road length with adjoining houses may be allotted to a sweeper depending upon the density of population in the given area and local conditions. In low density areas even 500 running meters of road length can be given. Normally 50 to75 houses coupled with the above road length may be taken as a yard stick for allotment of work to an individual sweeper.

3.2.2 Role of the Collector

The collector should ring the bell or blow the whistle announcing his arrival at the place of his work and start sweeping the street. The people may be directed that on hearing the bell or whistle they should put their domestic biodegradable waste into the handcart of the sweeper.

No collector may be expected or directed to do house to house collection by asking waste from the doorsteps to save his time energy and productivity.

3.2.3 Collection of waste from Societies / Complexes

In the private societies / complexes / multi stories buildings normally no collectors are provided by the local bodies and private collectors are generally engaged. It may be therefore be made compulsory for the management of the Societies / Complexes etc. to keep the bins in which waste has been stored at the easily approachable location to facilitate easy collection by the municipal staff. The local body shall arrange to collect waste from these community bins through handcarts, tricycles of pick up vans etc. as may be convenient on day to day basis.

3.2.4 Collection of Wastes from Slums

The local body shall collect waste from slums on bell system along their main access-lanes, with residents bringing their wastes to the handcart from their houses and / or from the community bins by using the pick-up vans or containerized handcarts or other means which may be convenient transferring the waste to the municipal waste storage sites for daily clearance. The local body may, if so desire engage a private contractor for daily collection of this waste. Performance certification by "Maholla / Bastee Committee" may be insisted in such cases.

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3.2.5 Collection from the door-steps in posh residential areas

In the posh residential areas where the residents might not be willing for community participation and bring their waste to the municipal hand cart, door-step collection of wastes may be introduced for picking up domestic waste from households on day to day basis. Such service may be provided on full cost recovery basis and contractor may be engaged to provide such service if so desired to ensure that the waste generated from posh area is collected regularly and taken to the waste storage sites.

3.2.6 Collection of Duly Segregated Recyclable / Non-degradable Waste from Households

NGOs may be activated to organize the rag-pickers in the city and the rag-pickers may be allotted lanes and bye lanes comprising of 150 to 250 houses for door-step collection of recyclables. The rag-pickers may be given identity cards by the NGOs for increasing their acceptability in the society. NGOs and / or the corporation may support the rag-pickers by giving them nylon bags for collection of recyclable waste from the door-steps.

3.2.7 Collection of Waste from the Shops and Establishments

The shops and establishments normally open after 9 a.m. These timings do not synchronize with the work schedule of the sweepers. Under this situation one of these three alternatives may be adopted.

1. Sweepers may first carry out the work of street sweeping in the morning hours as usual and soon thereafter take up the work of door-step collection of wastes, after most of the shops open.
2. Rag pickers may be organized to collect the recyclable waste from the shops and establishments as soon as the shops get opened as most of such waste is recyclable. Working arrangement may be made with the shops and establishments accordingly. The shops & establishments may be asked to store waste in two bins if they produce waste other than recyclable waste also. The rag pickers may be organized to collect recyclable waste from such establishments on a daily basis. This arrangement may be made on 'No payment' basis on either side.

   The recyclable material received by the rag-pickers directly from the shops and establishments would give them a better return. The waste would be dry and not soiled and would fetch a good price in the market. This will work as an incentive for them to continue door to door collection. The associations of markets, shops and establishments may be persuaded to make an endeavor in organizing this service with the help of NGOs and rag-pickers in their market.
3. Door-stop collection service from the shops and establishments may be contracted out on 'full cost-recovery' basis.

3.2.8 Collection of Hotel and Restaurant Waste

The hotels and restaurants may make their own arrangements of collection or be given door step collection service for their food wastes by the urban local body on full cost recovery and pro-rate basis. This door step service may be contracted out by the local body if so desired.

Charges for the collection of hotel waste may depend upon the quantity of waste to be picked up from the hotels and restaurants.

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The cost recovery may be planned according to the classification of hotel / restaurant made on the above basis and decided in consultation with them.

A survey of the Waste Generation of the hotel / restaurants may be made before the collection rates are introduced and notified.

3.2.9 Meat And Fish Waste

Meat and fish waste from the meat / fish markets should be removed on a daily basis departmentally or through contractor on full cost recovery basis.

3.2.10 Sweeping Of Streets & Public Spaces

Sweeping of all the public roads, streets, lanes, by-lanes should be done daily if there is habitation or commercial activities on both the sides or on either side of the street. A list of such roads and streets together with their length and width should be prepared and a programme of their daily cleaning should be worked out by the local body keeping in views the norms of work (yardstick) prescribed. However, the roads and streets, where there is no habitation around and they do not require daily cleaning, may be put in a separate group and may be taken up for cleaning periodically depending upon the need of cleaning those roads or streets. Cleaning of such roads, streets etc. may be included in the list of periodical cleaning of such spaces to ensure that they do not become the dump yards and remain clean. A programme should be worked out for cleaning such roads, streets and open spaces according to the periodicity of cleaning decided upon and may be adhered to.

3.2.11 Transfer Of Waste

Collectors shall transfer the waste collected from Door to door to a container kept at transfer station of their respective zones from where the container would be transported to dumping site by prime movers.

The waste collected in community bins / litter bins shall be directly transported to dumping site by prime movers.

Details of the transportation system and nature of vehicles have been given in Chapter 4 below.

3.3 Tools to be given to Sweepers

With a view to ensure that the sweepers, more particularly female workers can work conveniently, appropriate types of tools and equipment should be given to them.

3.3.1 Brooms

The brooms should have a long handle to facilitate cleaning of the street without bending the body. In the cities where the broom allowance is being given or only broom sticks are provided to the sweepers, it should be ensured that long handle brooms are used or made by them for street sweeping. While making such brooms, a metal blade which can scrape the material sticking on the street should be fixed on the top of the broom or a separate metal scraper may be given to the sweepers to remove the sticking material from street while sweeping.

There is no yardstick about the number of brooms to be given to the sweepers per month. In some cities three brooms are given per month whereas in some cities only one broom is given per quarter of a year. One long handle broom per month considered being adequate for street sweeping. The bamboo

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(long handle) to which the broom is attached need not be given once a month as it has a long life. The same bamboo should be reused while making the broom. The bamboo may be replaced as and when required. It could be once in six months or once a year depending upon the local conditions of the city.

3.3.2 Metal Tray and Metal Plate

Each sweeper engaged in the street sweeping should be given a metal tray and a metal plate in for facilitating easy transfer of street sweeping from the streets into the handcart.

3.3.3 Hand-Carts / Wheel Barrows

Each sweeper engaged in street sweeping should be given a handcart having 8 containers of 20 liters capacity each. These containers should be detachable to facilitate the direct transfer of street sweeping from the container into the communal waste storage bins. Such containers should be lockable with a chain arrangement. The handcart should have sealed ball bearing and at least 3 wheels so that it can be used efficiently. Containerized tricycles can be used in lieu of the handcarts.

3.3.4 Norms Of Work For Street Sweepers

The sweepers may be assigned "Pin point" work according to the density of the area to be swept. The following yardstick can be adopted :

1. In high density area 300 RMT of road length covering about 200 to 175 houses
2. In medium density area 500 RMT of road length covering about 150 to 125 houses
3. In low density area 750 RMT of road length covering about 125 to 100 houses

The sweepers may be directed to sweep the roads and footpaths in the area allotted to them as well as to collect the domestic, trade and institutional wastes in their handcart from the households, shops and establishments situated on the road / street allotted them.

3.3.5 Cleaning of Surface Drains

In most of areas of Midnapur Municipality there are open surface drains. In these drains quite often the sweepers and the people dispose of the waste un-authorized. These drains are required to be cleaned on regular basis to permit free flow of waste-water. Action should be taken to ensure that the sweepers and the citizens do not dispose of their waste into the drains.

Drain cleaning should be done regularly at least twice in a weak and the cleaner should be given suitable handcarts and shovels for transferring the waste to the site identified for depositing such waste. The periodicity of cleaning such drains should be worked out looking to the conditions of clogging of drains.

3.3.6 Provision of Litter Bins

For the facility of the citizens to dispose of their waste in hand such as used cans of soft drinks, used bus tickets, wrapper of chocolate or empty cigarette cases etc. litter bins should be provided in all the market places, office complex areas, places of public gathering and on the important roads at reasonable distance ranging from 25 meters to 250 meters depending on the density of the road or market place. The removal of waste from these litter bins should be done by the sweepers during their street cleaning operations. The waste from the litter bin should be directly transferred into the handcart of the sweeper.

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Such facility may be created at no cost to the local body by involving the private sector and giving them advertisement rights on the bins for a specified period or by allowing them to put their name on the bins as sponsor. Litter bins should be put in posh as well as poor areas and the sponsor should put such bins in both the areas in the proportion decided by the local body.

3.3.7 Temporary Waste Storage Depot for Bulk Community Waste

The Bulk community waste storage has to be properly linked with Collection System adopted by the city / town where house to house collection.

The local body may depend upon the system of Collection adopted in the town, identify the locations where community waste storage facilities shall be created.

3.3.8 Segregation Of Recyclable / Non-Degradable Waste

The local body shall make serious endeavor to motivate households, shops and establishments to segregate recyclable / non-degradable wastes at the source of waste generation and hand over such waste to the rag-pickers. The arrangement may be made on 'no payment on either side basis' for collecting the recyclable / non-degradable wastes by the rag-pickers and simultaneously mobilize NGOs to take up the work of organizing rag-pickers and motivating them to collect recyclable wastes from the doorstep instead of picking up solid waste from the streets, bins or disposal sites. This step may create some earnings to some BPL persons.

The Local Bodies may actively associate resident associations, trade & street associations & NGOs in the awareness campaign to motivate people for segregation of such waste at source.

Priority must be given for the source segregation of recyclable wastes by shops and establishments. Efforts may be made to introduce segregation of recyclable waste at source and its collection from the doorstep by the rag-pickers. In case of households such an arrangement may be made within one year.

The rag-pickers may be given an identity card by the NGOs organizing them so that they may have acceptability in the society. The Local body may notify such an arrangement made by the NGOs and advise the people to cooperate.

As soon as this arrangement is made and a reasonable awareness campaign is carried out it shall be made compulsory to do source-segregation from the date that may be notified by the local body.

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4.0 TRANSPORTATION OF WASTE

Transportation of waste is very important aspect so far cost is concerned. Proper planning and management of man machine and vehicle is of utmost important to minimize the cost.

a) The waste collected from door-to-door shall be transferred to transportation containers viz. **Hook Lift Dumper Containers 5 to 7.5 cu.m. capacity (HLDC), Hydraulic Dumper Container (HDC),** etc. kept at transfer station located at various zones.

b) The transportation of waste from the bulk community waste storage sites or transfer stations may be planned in accordance with the frequency of containers becoming full. The locations where the containers are placed may be grouped into four categories is given below. These containers should be of about 1000 ltr. capacity still bins with **Swivel Castor Wheel Automatic Lifting** arrangement and are to be transported directly to dumping site by prime movers .

a) The containers which are required to be cleared more than once a day.

b) The containers which are required to be cleared once a day.

c) The containers to be cleared on alternate days or twice a week.

d) The containers which take longer time to fill to be cleared once a week.

The various types of transportation vehicles which may be used for transportation of waste from Midnapur Municipal area to dumping site are **Hook Lift Dumper Carrier (Hydraulic), Hydraulic Dumper Carrier, Tractor-Trailer, Ordinary Truck.**

4.1 Transportation Of Waste From Hotels & Restaurants

The hotels and restaurants waste shall be collected on day to day basis either departmentally or through a contract. Door-step collection system may be introduced for the collection of this waste. Eight refuse collectors with back loading facility or motor vehicle with close body may be used. This entire collection and transport system could be privatized and rates may be prescribed by the local body. 33% spare vehicles may be kept to ensure reliable service.

4.2 Transportation of Construction Waste

Removal of construction waste is the liability of waste producer. If he does not remove the construction waste, it may be removed by the local body on full cost recovery basis. One of the following methods may be adopted for transportation construction waste:

i) Here skip renting system may be introduced; the skips shall be transported by hydraulic system at the time mutually agreed between the parties i.e. local body and waste producer.

ii) The local bodies may also use front-end loaders and trucks, hydraulic dumper truck for transportation construction waste.

4.3 Transportation of Waste from Narrow Lanes

Quite often small quantity of waste is disposed of in the narrow lanes which cannot be removed by sending out usual transport vehicle. Wheel barrows may be used for removal of such waste.

Small vehicles may be used for the collection of waste from narrow lanes and transfer the same to containers kept at nearby transfer station for transportation of waste to dumping site. The transfer stations

itself should be transported to the dumping ground by the Prime Movers. Facility of ramp may be provided for transferring the waste from the collecting vehicles to the transportation vehicles. The requirements of such large container are worked out on the basis of total quantity of waste expected to be brought to the transfer station.

4.4 Type of Vehicles to be Used

The vehicle which synchronizes well with the community waste storage system shall be utilized to prevent multiple handling of waste which may be done as under.

i) Wheel Barrows with 8 containers of 20 lts. Capacity; 4 for Bio-degradable and 4 for non-degradable for house to house collection for solid waste.

ii) The box type or wheel borrows are suggested to be replaced preferably with containers / bins in narrow lanes.

iii) The filled up containers are proposed to be hauled away by prime movers and in doing so the filled up skips / containers / trailers being replaced by empty one. The transfer station needs to be designed in a proper manner by constructing suitable ramps and vehicles bays for transferring waste from the primary collection fleet to transportation vehicles / containers.

iv) The container lifting devises such as Dumper placers / skip lifters/ Hook Lift Dumper Carrier may be utilized for transportation of large size containers to the transfer station of the disposal site.

4.5 Routing of vehicle

Routing and scheduling of vehicles are of prime important for management of waste transportation system. Depending on the containers to be cleared each day, the route for lifting the container may be worked out avoiding zigzag movement of the vehicle to the extent possible.

4.6 Workshop Facility for Repairing and Maintenance of the Vehicles

Midnapur Municipality must have adequate workshop facility for the regular maintenance to the various types of accessories and fleet of vehicles. Such facility may be created by the local body departmentally or through a contractual arrangement. The workshop should have adequate technical staff and spares to ensure that at least 80% of the vehicles remain on the road each day and the down time of repair / maintenance is minimized to the extent possible. Spare assemblies should be kept available which could give as replacement till such time necessary repairs are carried out. The workshop should be preferably headed by an automobile or mechanical expert.

Team incentives should be introduced in workshop for ensuring more than 80% of vehicles on the road throughout the month.

The workshop should be run in more than one shift. Technical staff as per the requirement may be kept in the second or third shifts to ensure that more than 80% of vehicles remain on the road for optimum utilization of the fleet of vehicles of the local body.

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However facilities for Collection and Transportation will be dealt with Phase II of the DPR.

5.0 DISPOSAL OF WASTE

The disposal of waste, processing of degradable waste and disposal of non-degradable waste, is one of the most important aspects of integrated waste management as unscientific disposal of waste can cause irreparable damage to the environment and subsoil strata and human health and life. No local body should therefore allow any dumping of waste at unauthorized sites. Suitable landfill sites must therefore be urgently identified and designated as Landfill Sites for the disposal of rejects from the Compost Plant and for non-biodegradable waste. Municipality should arrange required land for disposal of waste keeping in view the requirements of the city for at least the next 15 – 20 years. Depending upon the quantity of waste to be disposed of annually, the requirement of land has been worked out below and the land may be acquired accordingly.

Composting is the process of waste disposal which our predominantly agricultural country must follow. It can be done by aerobic and anaerobic processes. The aerobic process is a biological oxidation process where the organic portion of the waste is decomposed and a material useful to agriculture having N: P: K values is produced. This process can be completed in 45 to 50 days.

An aerobic process of composting is very slow. It takes about 180 days to make compost. It is therefore not desirable to go for anaerobic composting. Besides it does not kill pathogens.

The aerobic composting is suitable under Indian conditions. Indian waste generally contains 30% to 50% of organic wastes. It also has the required moisture content, C/N ration etc. It is a low cost option and does not require high skills. It has a market potential and land requirement for disposal of waste gets reduced.

Disposal of SW involves processing of bio-degradable portion of the waste into manure and generation of bio gas and disposal of the remaining after recovery of recycleable materials of the total solid waste.

DISPOSAL TECHNOLOGIES

Technology Comparison

The following technology options were considered as a solution for the solid waste management facility:

1. Scientific landfill for handling the entire solid waste generated.
2. Windrow and or Vermi Composting
3. Waste to Energy via Incineration
4. Waste to Energy via Syngas (Gasifier or Plasma Arc) process
5. Sorting followed by bio-gasification

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The following table provides the summary of the comparison :

Technology	Land Requirement	End Product	Viability
Scientific Landfill	High. Does not need sorting to function	Landfill gas at low rate for several years.	Will need substantial land and high capital cost to construct. The gas generation is gradual. Not viable primarily due to land constraints
Windrow or Vermi Compost	Moderate. Needs sorting to operate	Compost	Difficult to have all the compost consumed by the customers. A few days of lack of collection will lead to accumulation at the site. Uncertainty of feed quality will also cause reluctance among farmers to accept the final product. Limited viability.
Waste to Energy: Incineration	Moderate. But needs land for ash/residue disposal	Electricity	High moisture and low carbon in the waste makes the process very inefficient leading to very low electricity generation. Air pollution is also a major concern. The land requirement goes up due to the Requirement of ash dispoal within the premises. The capital cost is also very high. Not viable
Waste to Energy: Syn Gas	Moderate. Needs land for ash disposal	Electricity	High moisture and low carbon in the waste makes the process very inefficient leading to very low electricity generation. The land requirement goes up due to the Requirement of ash dispoal within the premises. The capital cost is also very high. Not viable
Bio-methanation after sorting	Relatively low. But needs sorting for functioning.	Biogas/Electricity and Organic Fertilizer	If sorting is done properly, the gas (and if converted to electricity) is viable end product. No end residue of the process other than the products. The cost is reasonable. Viable for these applications.

Based on above criteria Bio-methanation after sorting is hereby proposed for Biodegradables and Sanitary land fill for the inert.

5.1 Generation of BIO-GAS

According to the Midnapur Municipality estimation, approximately 75 MT of waste is generated daily basis in the Midnapur Town. It was seen that for the Midnapur Municipality the amount of the Biodegradable Waste generated (44 MT) was considerably higher in comparison to the Non Biodegradable waste. Thus, a Bio gas Plant layout is ideal for the Project Area and will be designed for the Midnapur Municipality. Primarily, **EIGHT 5 MT** Bio gas Plants are proposed for Midnapur Municipal Area.

At a glance, the benefits which can be drawn out of Solid Waste Management are as follows:

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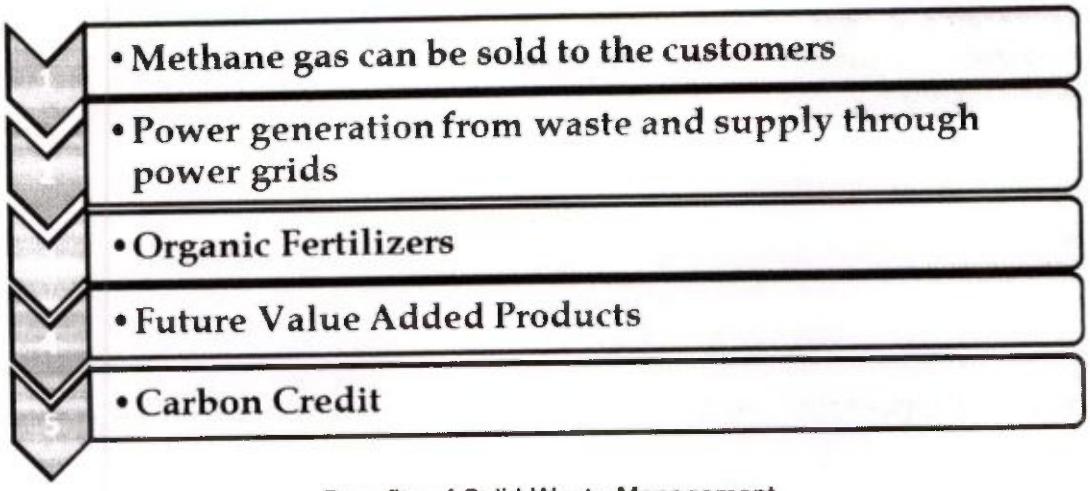


Benefits of Solid Waste Management

Waste Generation Trend

Midnapur is a Municipality well known for its tourism and horticultural importance in West Bengal. Following are the major sources for generation of Solid Waste:

Domestic;

Commercial Areas and Vegetable Markets;

Household and other factories;

Hotels and Restaurants;

Health Care Facilities

Slaughter House;

Street Sweeping and Construction Activities

Horticultural Waste

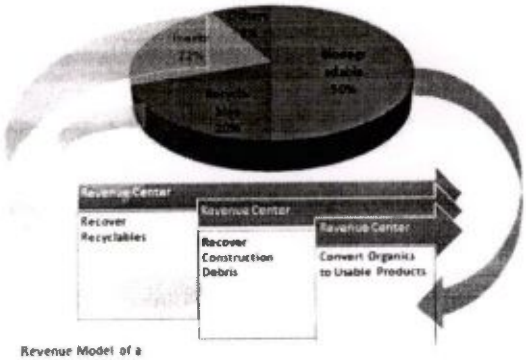
The following diagram shows the proposed approach for a comprehensive solid waste management system. The overall solution should be a combination of the following:

Sorting and segregation

Recovery of Recyclables

Recovery of inerts

Conversion of biodegradables to valuable products like biogas and fertilizers



Revenue Model of a Comprehensive Solid Waste Management System

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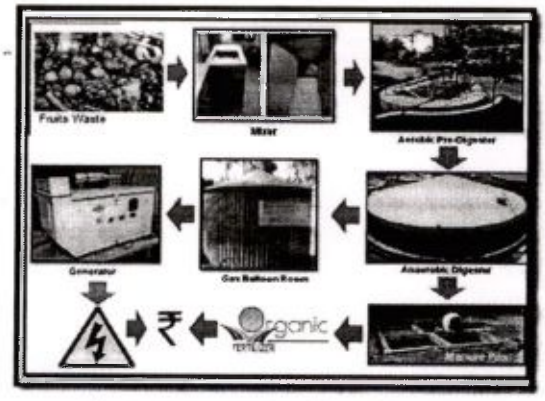
Solid Waste Sorting Operation

The collected solid waste will be segregated into biodegradable and non biodegradable components. The non-biodegradable components will be sorted into paper, plastic, glass, metals and inerts. There is a ready market for all of these sorted materials in Siliguri and other urban centers for these recyclable markets. It is recommended that Midnapur assigns one of the companies operating in the region for sorting the waste so that the biodegradable component can be fed into the biogas generating facility.

Solid Waste Handling Technique

Approximately 75 MT of solid waste is generated on a daily basis. Thus the expected Biodegradable Waste to be generated daily is approximately 44 MT. It is recommended that biogas plant should be setup for optimal utilization of the processed waste.

Science of the Process



Waste Processing Flow Diagram

The principle as explained in the figure above produces organic manure (soil conditioner) and biogas based on the process of Bio-Methanation. The organically rich biodegradable portion of solid waste is mixed with recycled water to form slurry. The slurry is then aerobically digested in Pre-digester, where organic matter is converted to organic acids. Prior to Pre-digestion, final digestion is required. The Pre-digestion is accentuated by addition of hot water and intermittent aeration. Pre-digestion reactions are exothermic and temperature rises to 40 ºC by itself. Hot water obtained using solar heater is added to raise the temperature to 50 ºC. Their main role is to digest proteins and low molecular weight carbohydrates to produce volatile fatty acids.

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The smaller molecules like proteins and simple carbohydrates are degraded during Pre-Digestion. The pH of the feed slurry to Pre-digester is around 7-8. The retention time (Hydraulic time) of 4 days is maintained in the Pre-digester. After the Pre-digestion the pH reduces to 4-5 pH units. The predigested slurry is further digested under anaerobic conditions for about 15 days. The process of methanogenesis takes place in this digester. Methane and carbon dioxide are the terminal products of this process. Methane is produced from two primary substrates viz. Acetate and Hydrogen/ Carbon dioxide (Formate). At this stage the organic acids are converted by consortium of methane bacteria to methane and carbon dioxide. The undigested lignocelluloses and hemi celluloses then flow out as high quality organic manure slurry. The pH of this slurry ranges from 7.5-8. Since the waste is processed at higher temperature, weed seeds are killed completely and the manure becomes weed free.

The three steps of Biogas production are as follows; 1) Hydrolysis 2) Acidification and 3) Methanogenesis. Various bacteria are involved in these processes.

Hydrolysis

In the first step (hydrolysis), the organic matter is analyzed externally by extra cellular enzymes (cellulose, amylase, protease and lipase) of microorganisms in the pre-digester tank. Converting solid waste into liquid form in the mixer stimulates this step. Bacteria start decomposing the long chains of the complex carbohydrates, proteins and lipids into shorter parts. Proteins are split into peptides and amino acids. Simple carbohydrates and proteins are degraded completely.

Acidification

Acid-producing bacteria involved in the second step convert the intermediates of fermenting bacteria into acetic acid (CH3COOH), hydrogen (H2) and carbon dioxide (CO2) in the Pre-digester. These bacteria of the genus bacillus, are aerobic and facultative anaerobic, and can grow under acidic conditions. The aerobic conditions in the pre-digester will be maintained by an air compressor..The bacteria use the oxygen dissolved in the solution producing acetic acid, thereby reducing the compounds with a low molecular weight into alcohols, organic acids, amino acids, carbon dioxide, hydrogen sulphide and traces of methane. The pH of the raw slurry falls from 7.5 to about 4.5 to 5.5 in the pre-digester. , Various zones are formed in the pre-digester and different bacteria dominate these zones. Addition of hot water helps in eliminating the mesophilic bacteria and selection of thermophilic bacteria. But these thermophilic bacteria can operate at lower temperatures also. Hence hot water added even once a day should be sufficient for maintaining the pure consortium in the pre-digester. However if it is possible to maintain the temperature of pre-digester in the range of 50-55oC throughout the day, the performance of pre-digester will be enhanced and the holding time may be further reduced, by maintaining temperature in the range of 50-55.C, throughout the day.. The hot water helps in hygienization of the slurry by killing the enteric bacteria that may be present in the waste. Some Gram negative Enterobacteria and Coliform bacteria have been isolated in the rawslurry. However in the second zone these bacteria are totally eliminated.

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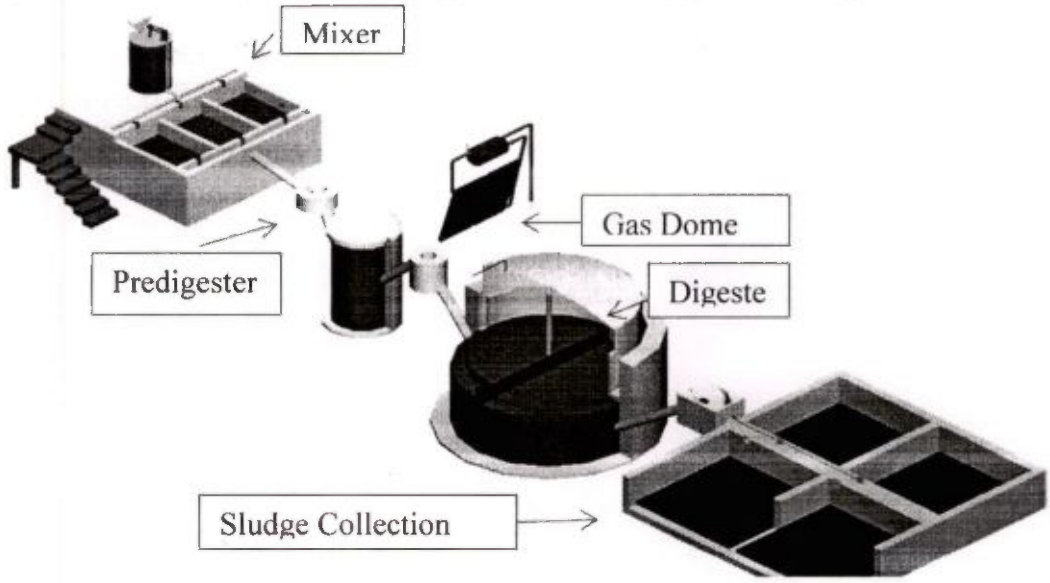
From the pre-digester tank, the slurry enters the main tank where it undergoes anaerobic degradation by a consortium of archaebactereacea belonging to Methanococcus group.

Methane Formation

Methane-producing bacteria, in the third step, decompose compounds with a low molecular weight. . In contrast to acidogenic and acetogenic bacteria, methanogenic bacteria belong to the archaebacteria group, a group of bacteria with a very heterogeneous morphology and a number of common biochemical and molecular-biological properties that distinguish them from all other bacterial genera. It is advisable to circulate the generated biogas back into the system using a small compressor. This would enhance the reduction of Carbon dioxide to methane and enrichment of methane fraction in the biogas. The separation of two stages in methane production helps in improving the purity of methane gas, thereby increasing its fuel efficiency. However, the average composition round the year would depend on how effectively pre-digester temperatures can be maintained. It is taken through a GI pipeline to utility points. Drains for condensed water vapor are provided online. The biogas burns with a blue flame and is ideal for cooking. Alternately, it can be used to produce electricity in a dual fuel biogas-diesel engine.



Process Schematic of the Waste to Biogas-Organic Fertilizer System

5.2 SANITARY LANDFILLING

This is presently the commonest method of waste disposal. But it has associated problems of land and sub soil water contamination besides availability of land is becoming scares from year to year for filing of waste. Efforts have therefore to be made to minimize the wastes going to the landfill by resorting to composing of organic waste and only rejects should be land filled from the dates that may be notified by the local bodies after setting up of the Compost Plant.

This method will have to be followed for the greater mass of waste with a proper sanitation approach, in place of the present process of indiscriminate dumping. Adequate precaution against

leachate pollution, fly, insect, odor and other unsightly problems, will have to be ensured for proper environmental protection. The fuel gas generated at landfill site can be salvaged and put into proper use for energy recycling. Assistance from developed countries to achieve this object will be of high necessity. A conceptual arrangement for sanitary landfill system has been given below.

5.2.1 Identification of Suitable Lands for Disposal of Waste Site selection :

Local bodies must identify suitable landfill sites 1) for the disposal of rejects from the compost plants and 2) for making a secured landfill for the disposal of non-biodegradable items following the directions of central or state pollution control boards. Such sites should be large enough to meet their requirement of waste disposal for 15 to 20 years and capital investments could be made for making the site fit for disposal of wastes.

a) The landfill site should be at least 0.5 km. away from the habitation so that it does not cause nuisance to the people on account of emission of foul smell etc.

b) It should have relatively impervious soil strata.

c) It should have good approach roads.

d) It should large in size.

e) Landfill site should be very near to compost area to minimize transport cost.

f) Landfill site should not be very near to water bodies like lake, cannel, river etc.

5.2.2 Development of Site

a) If the soil has some porosity, it should be made impervious before being used for land filling, by liners of compacted clay, plastic of concrete.

b) Approach roads may be made to connect the landfill site to the main road.

c) Internal approach roads are made to facilitate easy movements of vehicles and tipping of wastes at the landfill site during the monsoon months.

d) The local bodies should set up monitoring stations near the major landfill sites to ensure that quality of subsoil water does not get affected on account of leachate emerging from the landfills. A leachate pit is required at the lowest point for pumping leachate.

e) A small store room may be constructed at the landfill site to store the tools and equipment required.

f) A compound wall or fencing by barbed wire may be done to prevent blowing of waste due to air, controlling the entry of unauthorized persons and conceal the unsightly appearance of the of the landfills. The site should be surrounded be adequate no. of trees.

g) In large cities having population above 5 lakh a mechanical or computerized weighbridge may be installed for monitoring the quantities of wastes being carried by the vehicles to the landfill.

h) Trees may be grown around to create a green belt to improve the environmental conditions and screen the site from the people vies.

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5.2.3 Landfill Operation

i) Compost-yard rejects and non-degradable may be brought to the landfill site for disposal.

j) Bulldozers may be used on a daily basis for spreading and compacting of such waste and covering it with inert material.

k) The waste may be covered with 7 to 10 cm. thick layer of inert materials such as construction wastes to avoid any foul smell and breeding of rodents and insects.

l) The landfills may be carefully monitored against subsoil contamination through leachate.

m) Gardens or playgrounds may be developed on the landfill and they may be made useful to the society or put to a profitable use.

n) On-site construction is not recommended for ten years after closure of the site (or 25 years in temperate regions).

o) Waste should not be allowed to be burnt at the landfill to avoid air-pollution.

p) Toilets should be constructed to prevent open defecation and make arrangements for extinguishing accidental fires.

q) Records may be maintained of the wastes received at the landfill and the number of trips made by each transport vehicle on day to day basis.

Landfill Section

Landfill may have different types of sections depending on the topography of the area. The Landfill may take the following forms: (a) above ground landfills (area landfills), (b) below ground landfills (trench landfills), (c) slope landfills, (d) valley landfills (canyon landfills) and (e) a combination of the above.

In case of Midnapur Town a combination of above ground landfills (area landfills) may be adopted.

Phasing of Landfills Operation

Landfill is to be 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.

Each phase is to be typically designed for a period of 12 months. Phases are generally filled from the base to the final/intermediate cover and capped within this period leaving a temporary un -restored sloping face.

It is recommended that a 'phase plan' may be drawn as soon as the landfill layout and section are finalized. It must be ensured that each phase reached the final cover level at the end of its construction

period and that is capped before the onset of monsoons. For very deep or high landfills, successive phases should move from base to the top (rather than horizontally) to ensure early capping and less exposed plan area of 'active' landfills.

The term cell is used to describe the volume of material placed in a landfill during one operating period, usually one day. A cell included 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. The purposes of daily cover are to control the blowing of waste materials; to prevent rate, flies and other disease vectors from entering or exiting the landfill; and to control the entry of water into the landfill during operation.

A lift is a complete layer of cells over the active area of the landfill. Typically, each landfill phase is comprised of a series of lifts. Intermediate covers are placed at the end of each phase; these are thicker than daily covers, 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.

5.2.4 Liner System for Control of Leachate

Leachate control within a landfill involves the following steps: (a) prevention of migration of leachate from landfill sides and landfill base to the subsoil by a suitable liner system: and (b) drainage of leachate collected at the base of a landfill to the sides of the landfill and removal of the leachate from with the landfill.

Liner systems comprise of a combination of leachate drainage and collection layer(s) and barrier layer(s). A competent liner system should have low permeability, should be robust and durable and should be resistant to chemical attack, puncture and rupture. A liner system may comprise of a combination of barrier materials such as natural clays, amended soils and flexible geo-membranes. Three types of liner systems viz. **Single Liner System, Single Composite Liner System and Double Liner System** are usually adopted.

a) **Single Liner System** : Such a system comprises of a single primary barrier overlain by a leachate collection system with an appropriate separation/protection layer. A system of this type is used for a low vulnerability landfill.

b) **Single Composite Liner System** : A composite liner comprises of two barriers, made of different materials, placed in intimate contact with each other to provide a beneficial combined effect of both the barriers. Usually a flexible geomembrane is placed over a clay or amended soil barrier. A leachate collection system is placed over the composite barrier. Single composite liner system are often the minimum specified liner system for non-hazardous wastes such as MSW.

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c) **Double Liner System** : In a double liner system a single liner system is placed twice, one beneath the other. The top barrier (called the primary barrier) is overlaid by a leachate collection system. Beneath the primary barrier, another leachate collection system (often called the leak detection layer) is placed followed by a second barrier (the secondary barrier). This type of system offers double safety and is often used beneath industrial waste landfills. It allows the monitoring of any seepage which may escape the primary barrier layer.

Considering the advantages of composting liner system, in Indian conditions it is recommended that for all MSW landfills the following single composite liner system be adopted as the minimum requirement.

a) A leachate drain layer 30 mm thick made of granular soil having permeability (K) greater than 10^{-2} cm. /sec.

b) A protection layer of silty soil of 20 – 30 cm thick.

c) A geomembrane of thickness of 1.5 mm.

d) A compacted lay barrier and amended soil barrier of 1 mm thick having permeability (K) 10^{-7} cm. /sec.

To achieve good composite action the geomembrane must be placed against the clay with good hydraulic contact. To achieve intimate contact the surface of a compacted soil liner on which the geomembrane is placed should be smooth-rolled with a steel dump roller. All oversized stones in the soil should be removed prior to rolling. Also the geomembrane should be placed and back fill in a way that minimizes wrinkles.

Cut-Off Walls : When a landfill is underlain, at shallow depths, by an impervious layer, vertical cutoff walls may be constructed around a landfill to intercept off-site migration. Cut-off walls are physical barriers (typical made of bentonite or bentonite-soil mix) and such barriers are aided by active pumping used to remove leachates from within the perimeter of the cutoff wall.

Leachate Drainage, Collection and Removal

A leachate collection system comprises of a drainage layer, a perforated pipe collector system, sump collection area, and a removal system.

The leachate drainage layer is usually 30 cm thick, has a slope of 2% or higher and a permeability of greater than 0.01 cm/sec. A system of perforated pipes and sumps are provided within the drainage layer. The pipe spacing is governed by the requirement that the leachate head should not be greater than the drainage layer thickness. Pipe material selection is based on design requirements: HDPE pipes are most commonly used; other materials can also be examined for feasibility.

Leachate is removed from the landfill by (a) pumping in vertical wells or chimneys, (b) pumping in side slop risers, or (c) by gravity drains rough the base of a landfill in above-ground and sloped landfills. Side slope risers are preferred to vertical wells to avoid any down drag problems. Submersible pumps have been used for pumping for several years; educator pumps are also being

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increasingly used. In some landfills, the leachate is stored in a holding tank (for a few days) before being sent for treatment.

The possibility of fall in efficiency of the drainage system due to clogging associated with solid deposits and microbial growth can be controlled by a number of options, including back-flushing or breakthrough water after leachate head build-up.

Treatment of Leachate:

Control / Management of leachate is very complicated. The five/ alternative methods viz. **a) discharge to lined drains; b) discharged to waste water treatment system; c) re-circulation; d) evaporation of leachate; e) treatment of leachate** may be considered in this regard.

Out of the above five the Recirculation Method may be considered suitable for small to medium landfill site. This method of treatment of leachate is to re-circulate it through the landfill. This has two beneficial effects : i) the process of landfill stabilization is accelerated and ii) the constituents of the leachate are attenuated by the biological, chemical and physical changes occurring with the landfill. Recirculation of leachate requires the design of a distribution system to ensured that the leachate passes uniformly throughout the entire waste. This method also accelerates the process of gas generation.

Final Cover System

A landfill cover is usually composed of several layers, each with a specific function. The final cover system must enhance surface drainage, minimize infiltration, vegetation and control the release the landfill gases. The landfill cover system to be adopted will depend on the gas management plan by (a) controlled passive venting; (b) uncontrolled release; or (c) controlled collection and treatment/reuse.

For all landfill sites where controlled gas venting is planned, the cover system is recommended. Gas vents will be placed at a spacing of 30 m to 75 m on the landfill cover and the level of methane will be monitored regularly. If methane concentration exceeds permissible limit a gas collection and treatment system will be installed with flaring facility.

For sites where landfill gas recovery is to be undertaken, the placement of passive and/or active gas venting systems will be governed by the energy recovery system. In such case a cover of granular soil of 45 cm thick over the waste followed by barrier layer of compacted clay of 60 cm deep followed by a protection layer of 2 cm is to be given. Over the protection layer one layer of granular soil of 30 cm followed by a top layer of thickness 45 cm with soil suitable for vegetation growth will improve the efficiency of gas recovery system by minimizing the loss of gas to the environment.

For uncontrolled release of gas (in small, shallow and remote sites) a cover of 60 cm depth is recommended.

The cover system adopted at any landfill must satisfy the minimum requirements published by regulatory agencies CPCB.

Slope Stability Aspects and Seismic Aspects

The stability of a landfill should be checked for the following cases.

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1. Stability of excavated slopes.
2. Stability of liner system along excavated slopes.
3. Stability of temporary waste slopes constructed to their full height (usually at the end of a phase).
4. Stability of slopes of above-ground portion of completed landfills.
5. Stability of cover systems in above-ground landfills.

Closure and Post Closure Maintenance of Landfill Site

Determination of the end-use of a landfill site is an essential part of the plan for landfill closure and post-closure maintenance. Some possible uses of closed landfill sites near urban centers include parks, recreational areas, golf courses, vehicle parking areas and sometimes even commercial development.

A closure and post-closure plan for landfills involves the following components:

- Plan for vegetative stabilization of the final landfill cover.
- Plan for management of surface water run-off with an effective drainage system.
- Plan for periodical inspection and maintenance of landfill cover and facilities.

5.3 Introduction of Recycling System

In view of the fact that municipal wastes constitute variety of materials which have a good salvage value. Prospect of alternative disposal system based on the traditional practice can be explored in the non formal sector. We may also develop some resource recovery approach which propose to include :

i) Improved sorting technique and reduction of occupation hazards of pickers.

ii) Measures to reduce the health risk of workers.

iii) To develop a comprehensive plan of the existing agro pisi-culture system to improve utilization of garbage to increase productivity of vegetables and fish.

5.4 Disposal of slaughter-house waste and carcasses of dead animals etc.

The disposal of slaughter house waste and carcasses of dead animals should be done scientifically following the directions / guidelines of the Ministry of Environment, Govt. of India. This waste should not be mixed with municipal waste.

This waste could be converted into a useful product by installing a carcass-utilization plant with financial support Govt. of India's Ministry of Agriculture and Animal Husbandry.

Municipal authority should take appropriate steps for lifting, transportation and disposal of Carcass. Suitable mechanism is required to be developed for reporting of the dead animals found with in the municipal area. On receiving the information the "Dead Animal Carrier Van" should reach the spot as soon as possible but not later than one hour to lift the Carcass and to transport the same to dumping ground. The "Dead Animal Carrier Van" should be a covered one having chain-pulley system for lifting and placing the dead animals into the van. There are number of options for disposal of carcass.

The best method is to keep the dead animal in open air on an impervious platform at the remotest corner of the dumping ground so that it can be used as food for vultures. This is the most economic and easy method of disposal of carcass. Survival of vultures has become very important now a days for

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maintaining the ecological balance and this method of disposal of carcass will be very much effective in this regard.

The other options are :

i) Secured burial of carcass in impervious burial pits. This method is to be adopted where the dumping ground is located very near to the locality.

ii) A raised platform may be constructed to keep the dead animal in open air for feeding the same as food for vultures. This method may be adopted where the dumping ground is located far away from the locality.

iii) Shred the carcass into small pieces and mixed it in windrow where Windrow Composting facility exists. This will not only increase the process of decomposition but also will enhance the nutritious value of the compost manure.

The skin of the animal, if valuable, can be extracted before it is disposed off. After the carcass is feed by the vultures, the bones can be collected for use in bio-fertilizer.

In slaughter house liquid waste should be carried separately to the septic tank where anaerobic decomposition will take place and the effluent from the tank may be discharged to the normal drain after chlorination. Carcass of the slaughter house may be mixed with the vermi compost after initial decomposition of the same in solar light.

Private parties / NGOs may be engaged for collections and transportation of carcass on service charge basis. They may be allowed to extract the valuables from the carcass to minimize the cost of operation.

5.5 Disposal of Industrial Waste

Industrial waste is required to be stored, transported and disposed of by industries as per the guidelines of the respective State Pollution Control Boards. However, the local bodies may extend help to the industries in the transportation and disposal of non-hazardous industrial waste on full cost-recovery basis. This work can be contracted out by the local bodies in consultation with the industries associations etc. and strictly monitored by both the local body and the State Pollution Control Board.

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6.0 DESIGN OF THE SYSTEM

6.1 Quantum of Solid Waste

The success of any solid waste management system largely depends upon the three factors (i) Collection, (ii) Transportation & iii) Disposal. So, to make success clear assessment on the quantity of solid waste to be handled is very much essential. In respect of Midnapur Municipality that solid waste generation is @ 275 gm/cap/day is fairly reasonable for consideration.

Total quantity of waste generated per day from various sources in Midnapur Municipality is given below :

Category	Generation Points	Total (in kg.)	Quantity of Waste (in Kg.)	
			Waste Type	
			Bio-degradable	Non-degradable
A	Domestic	46510	27906	18604
	Daily & Wholesale Market	14000	11200	2800
	Hotels	184	74	110
	Agricultural/ Garden	700	700	0
	Sub-total	61394	39879	21514
B	Commercial Centres	5000		5000
	Railway Station	1000		1000
	Bus Stand	500		500
	Sub-total	6500		6500
C	Street Sweepings	1000		1000
	Drain Cleanings	1000		1000
	Sub-total	2000		2000
D	Cess pool	4500	4500	
E	Clinical	1199		1199
	Total	75592	44379	31213

Data Validation by Solid Waste Sampling

A detailed sampling exercise was performed at the Midnapur solid waste dumping ground to estimate the quality of the solid waste reaching the site. The assumption was that through the quantity of the waste will vary with seasons, the overall sorting practices and the solid waste generation points will remain the same during all the seasons.

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The following Table shows the result of the sampling exercise.

Tare Weight (KG)	Full Weight (KG)	Waste Total (KG)	Plastic (KG)	Metal (KG)	Glass (KG)	Paper (KG)	Rubbish/ Thermocol (KG)	Ash (KG)	Bio-degradable (KG)	Bio-degradable (%)
3280	5450	2170	110	5	5	10	300		1740	80%

The following conclusions can be drawn from the sampling exercise:

Nearly all the glass, paper and metals are sorted out of the solid waste even before it can reach the solid waste facility. One aspect that is a good practice as the recyclables are definitely gets recycled under this procedure.

The pre-sorting would reduce the revenue that the solid waste facility could have earned by selling the recyclables to the scrap market

The remaining plastic was mostly of low grade thin sheet. The only applicable process for conversion this plastic is to breakdown the plastic into dirty fuel through Pyrolysis so that it can be subsequently sold as furnace oil to factories.

The final solution will not require any process for recycling glass, metal and paper as these components can be expected to be drawn back into the economy.

The main revenue sources from the process will be from

- Gas and or electricity generated from the biogas
- Organic fertilizer
- Fuel oil from the plastic pyrolysis
- Selling any other recyclables recovered will be sold in the market through solid waste

Biodegradable materials will account for 85-90% of the waste finally reaching the solid waste facility. It is projected that as the waste reaching the solid waste site is after the sorting done by rag pickers and the residents, the biodegradable part as a percentage of the whole waste generated is expected to be close.

Therefore, the plant should be designed on the basis of the overall waste tonnage expectation while using the solid waste quality observed during the sampling process.

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BASIC CONSIDERATIONS

1. Per capita waste generated @ 275 gm/day and average family size is 5 persons.
2. Domestic Waste shall be segregated (bio-degradable and non-degradable) at generating points House to House in separate containers.
3. Each family would preserve the degradable waste in green container & non-degradable waste in yellow container.
4. House to House collection shall be done by Wheel Barrows having eight containers; four for bio-degradable and another four non-degradable waste.
5. There will be number of Transfer Stations in each zone .
6. At Transfer Stations waste from Wheel Barrow shall be transferred to Community Bins / Dumper / Refuse Trailer from a ramp.
7. Market Waste should be collected through Community Bin(s) to be placed at suitable points.
8. Trade Waste should be collected by Wheel Barrows or through Community Bin(s) to be placed at suitable points
9. Waste from Market shall have to be dumped in Transfer Stations. Each Market\Commercial Centre should have one Transfer Station in the form of containers. No road side open vat should be allowed. All road side bins must have cover and with necessary arrangement for tilting directly on to the transportation vehicles.
10. From Transfer Stations waste shall be transported to disposal site by prime movers.
11. Penalty may be imposed for haphazard throwing of waste.
12. Variety of non-degradable waste can be recycled after processing.
13. NGOs may be encouraged for employing daily wage earners to collect the non-degradable waste and to sale them.
14. One Wheel Barrow will cover about 50 to 75 holdings in a day and will make three trips to Transfer Stations.
15. Each and every hotels should keep two containers one yellow another green for storing their non-degradable & degradable waste respectively which shall be collected by the transportation vehicles at the particular time on each day.
16. Capacity of Refuse Trailer is 1.0 – 1.5 MT.
17. Capacity of Dumper / Truck is 5 – 7.5 MT
18. In an average one Tractor will be able to make 4 - 5 trips per day.
19. Moisture content in organic waste is about 60%.
20. Domestic SW contains about 60% organic matter and remaining 40% is inert materials.
21. Hotels generate SW @ 750 gm/bed and contains about 50% organic matter and remaining 50% is inert materials.
22. Market SW contains about 80% bio-degradable matter and remaining 30% is inert materials.
23. Assumed that Trade Waste contains about 10% bio-degradable matter and remaining 90% is inert materials.
24. Assumed that Agricultural Waste contains about 100% bio-degradable matter neglecting the very few mixed inert materials.
25. Assumed that Clinical Waste generated @ 1500 gm per bed/day.
26. In Clinical Waste infectious material is 25%.

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6.2 PROCESSING AND DISPOSAL OF WASTE

The solid waste of Midnapur Municipality is proposed to be disposed of partly by processing and partly by sanitary landfill method. Bio-degradable part will be processed bio gas will be generated.

Present land availability to Midnapur Municipality for disposal of SW is about 6.28 Acre located at a distance of 12 Km from the central place of the town. The detailed design of the disposal system is given below.

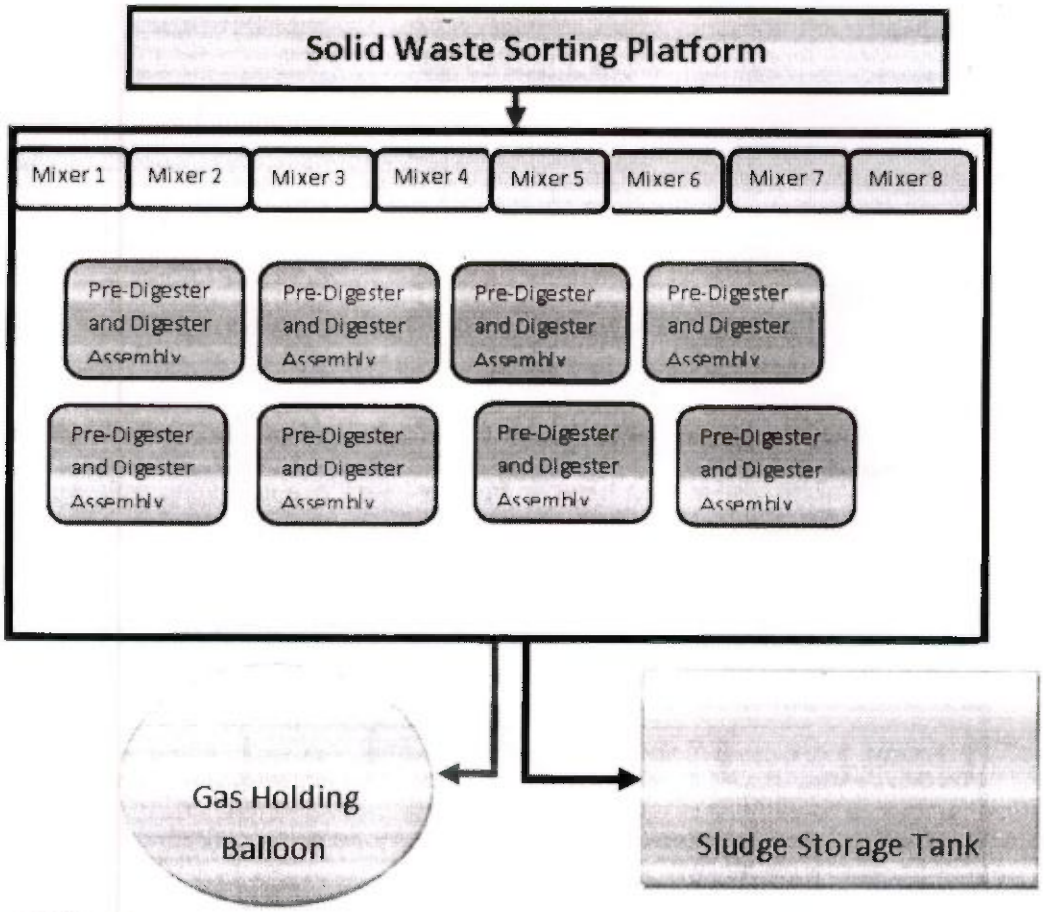
6.3.1 Design Of Solid Waste Processing System

The Solid Waste Management Facility in Midnapur Municipal Area is shown in figure below. It is proposed to be a Biogas Plant, which will produce electricity in the long run.

Proposed Solid Waste Management site

The Bio-Gas Plant at Midnapur Municipal Area

Total capacity to be provided at the site is 40 MT per day. This will be done by a combination of *eight 5 ton* plants. This would provide a sufficient redundancy and flexibility to the operation with changing load with different seasons. The Bio-Gas Plant Facility at Midnapur will require an area availability of approximately 1.2 Acre, to handle a capacity of 44 MT of Biodegradable wastes, on daily basis as shown in figure below. Any additional available land can be used as a sorting facility.



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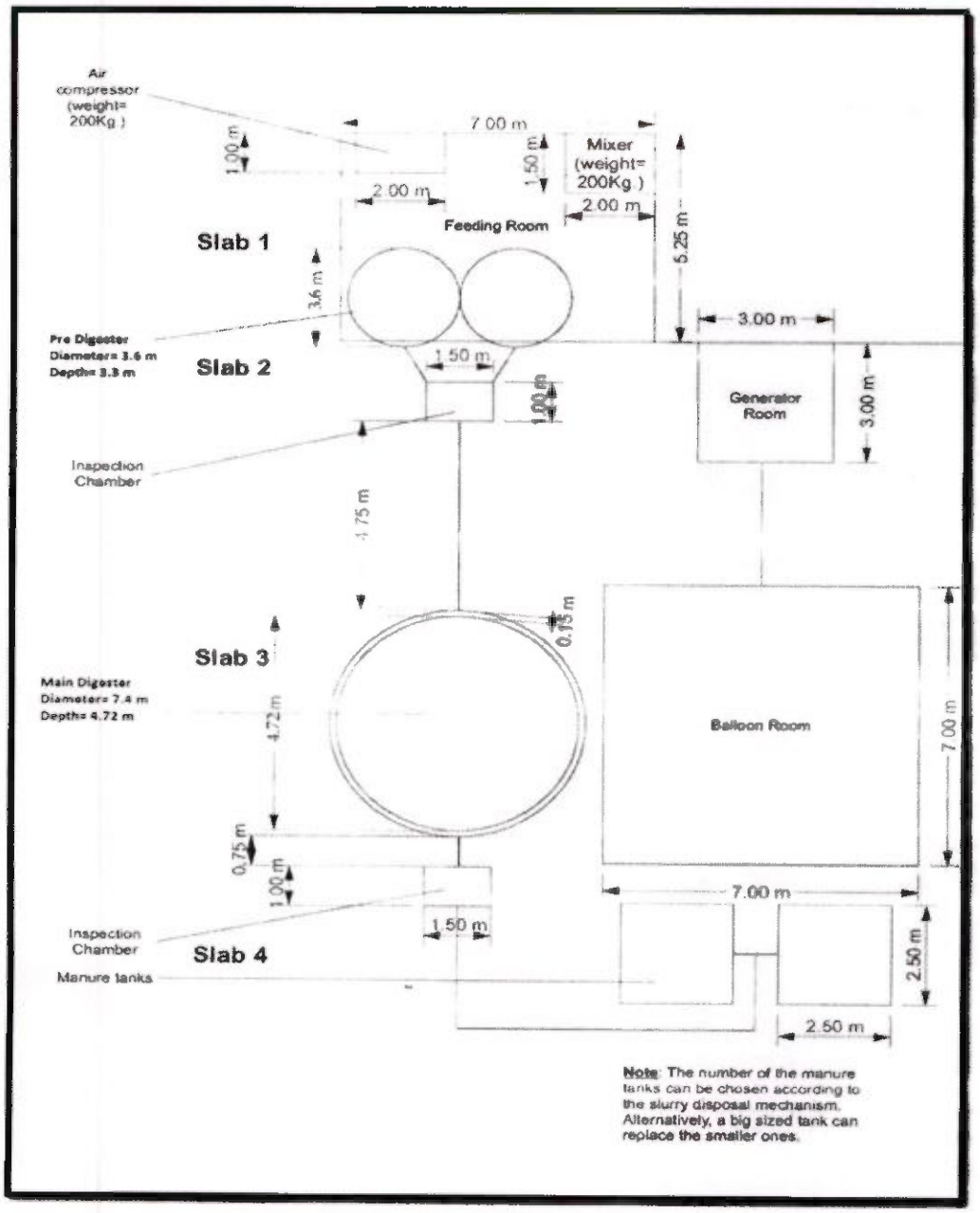

Proposed Biogas Plant Layout (each 5 MT Plant) for Midnapur Solid Waste Management

Components of Biogas Plant

Following are the major components will be installed at each of the SWM Facilities (Biogas Plants) in Midnapur, West Midnapur District as shown in the figures below.

- **A Mixer for crushing the solid waste**

Here the organically rich bio-degradable portion of solid waste is mixed with recycled (depending on availability) and/or fresh water to form a uniform slurry. The water ratio needed for this technology is 1:1 i.e., for 100 kg of waste, 100L of water will be needed. All of the required water need not necessarily be fresh water; Recycled water from the plant and from Sewage treatment plants can also be used. It is

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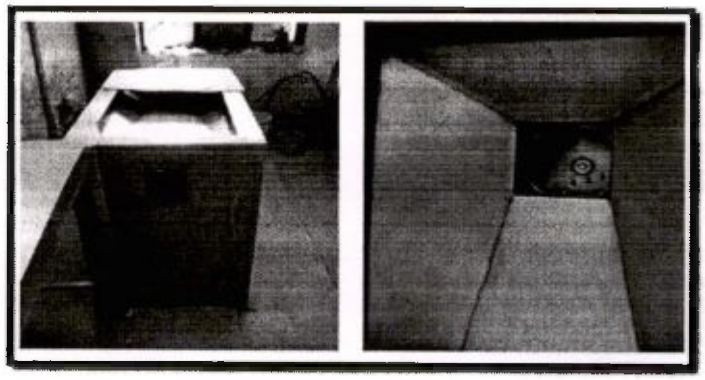
important to maintain the ratio, as addition of excess amount of water can lead to washing away of culture, thereby ceasing the process. The microbial quality of water needs to be checked regularly.



A Typical Mixer for crushing Biodegradable Waste

- **Thermophilic Aerobic Pre-Digester Tank**

Each 5 MT Bio-Gas Plant will have two Aerobic Pre-Digesters. Each Pre-Digester will be 2500 mm in diameter and 4000 mm deep. The Pre-Digesters will be aerobic in nature as name suggested. The Pre-Digester will receive flow of oxygen through air supplied by compressor housed in the Mixing and Feeding Room. The slurry will be aerobically digested in the pre-digester, where organic matter is converted to organic acids. The pre-digestion is accelerated by addition of hot water and intermittent aeration. Predigestion reactions are exothermic and the temperature rises up to 40°C by itself. The main role of the bacteria is to digest proteins and low molecular weight carbohydrates to produce volatile fatty acids. The retention time in the pre-digester is 4 days. Before introducing the slurry in the Main Digesters, it will pass through 1500 mm x 2500 mm inspection chambers. The aeration grid in the chamber will be as shown in figure below.

A Typical Pre-Digester

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- **Air Compressor**

The air compressor will be placed in the Mixing and Feeding Room. The pre- digester requires aerobic condition. To maintain aerobic conditions in the pre-digester aeration is given at regular intervals using a compressor. Aeration not only supplies oxygen but also enhances the uniformity in the slurry and in-turn promotes proper digestion for further fermentation in the main digester.

Typical Air Compressor

- **Solar Unit for Hot Water**

The Solar Power will be used for heating water which will be used for raising temperature in Aerobic Pre-Digester. Low temperatures arrest microbial growth and halt the process of bio-methanation.

- **Main Digester tank**

This is the heart of the Biogas Plant. There will be a main digester for each 5 MT Plant. The digester will be anaerobic in nature. The Main Digester will be 5400 mm in diameter and 6000 mm deep with floating roof. The predigested slurry will be further digested under anaerobic conditions for about 15 days. The process of methanogenesis takes place in this digester. Methane and carbon dioxide are the terminal products of this process. At this stage the organic acids are converted by consortium of methanogenic bacteria to methane and carbon dioxide which get collected in the dome above the main digester. The excess gas will be stored in a gas balloon as shown in the figure below. The undigested slurry will be transported to Manure Pits as explained below.

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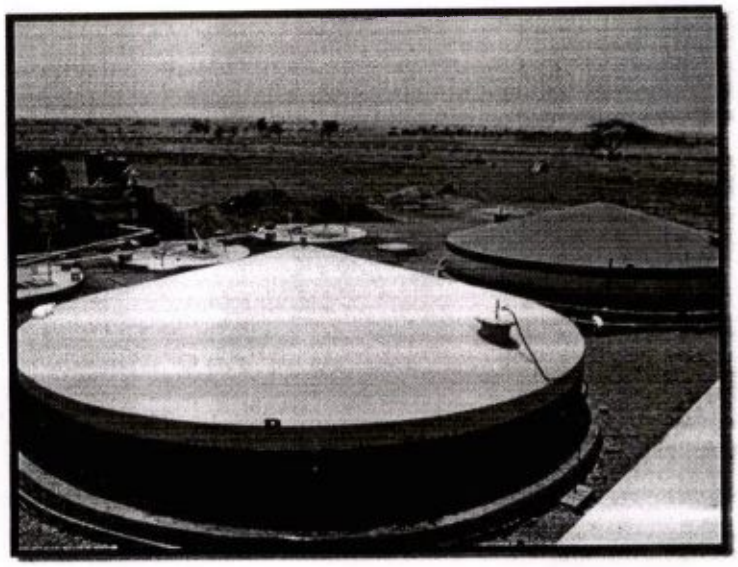
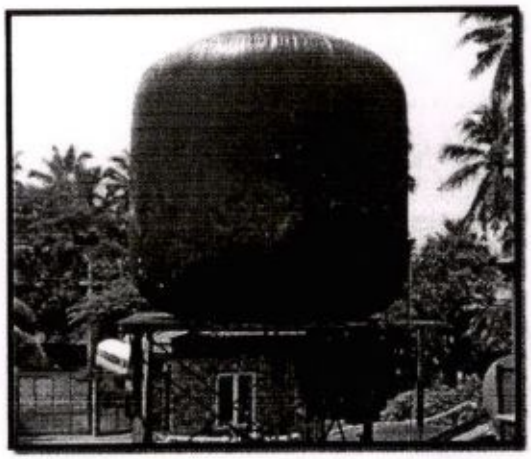


Typical Anaerobic Digester

- **Gas Holder/Gas Balloons**

Balloons are required to store the gas produced, when the production is higher than the utilization, as this results in the gas escaping from the water seal.



A Typical Gas Balloon

- **Manure pits**

The undigested lignocelluloses and hemicelluloses that flow out of Main Digesters as high quality organic manure slurry. The pH of this slurry ranges from 7.5-8. Since the waste is processed at higher temperature, any weed seeds are killed completely and the manure becomes weed free. Depending upon the raw materials used and the conditions of digestion, this sludge contains many elements essential to plant life – Nitrogen, Phosphorous, Potassium plus small amount of salts (trace elements), indispensable for plant growth such as boron, calcium, copper, iron, magnesium, sulphur, zinc, etc. It is a good source of all the essential elements needed for restoring the fertility of the soil. The Manure Pits will be located on end of the 5 MT Biogas Plant as shown below.

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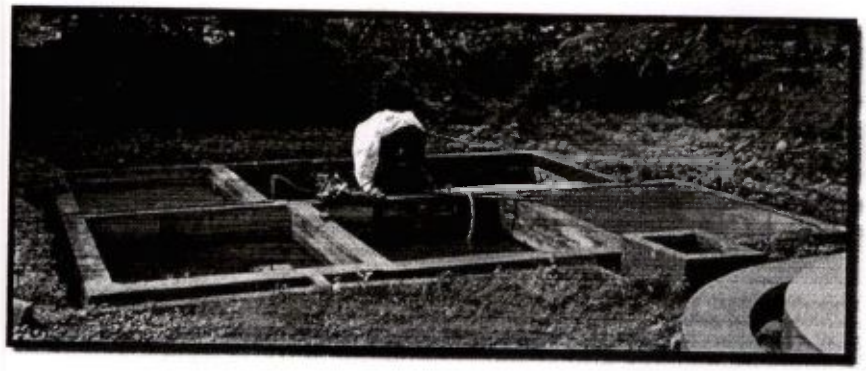

A Typical Manure Pit

- **Effluent water collection and recirculation system**

The sludge flows out into the manure pits, the water separated here is recycled to the mixer for feeding.

Hence brick/concrete tanks are used to store this water.

6.3.2 Technical Specifications of Bio-Gas Plant

Specifications of the Tanks & Pits

Table 3:

Specifications of the Tanks & Pits

S.No	Description	Nos	Dimensions	Volume of Each Tanks/Pits/ (cu.m.)	Total Volume of Tanks/Pits (cu.m.)
A	Primary Digester	2	3.6 m Dia x 3.3 m Deep	33.57	67.14
B	Main Digester	1	7.4 m Dia x 4.72 m Deep	202.90	202.90
C	Manure Pits	4 Cells	4.0 x 4.0 x 4.35	72	288
D	Outlet Chambers	2 Cells	2.050 x 8.0 x 1.65	12.38	24.79
E	Water Recycling Tank	1	: 5.95 x 2.7 x 1.75	28.11	28.11

Specifications of the Mechanical Equipment

Table 4:

Specifications of the Mechanical Equipment

S.No	Description	Specifications
A	Mechanical Mixer	7.5 HP/7 KW with double cutting arrangement
B	Compressor	3 HP/3 KW Phase 3 Fauji Make
C	Slurry Pump	3 HP/3 KW

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As mentioned earlier, the following equipment will be installed at the plant:

Specifications of other Ancillary Items

Table 5:

Specifications of the Ancillary Items

S.No	Description	Specifications
A	Main Digester Gas Dome	4 mm M.S. Sheet with FRP coating
B	Gas Pipeline	GI pipe Class C
C	Air Compressor Grid in Pre-Digesters	GI Pipe Class C
D	Bio-gas Balloon/Bag for extra Gas Storage	Polyethylene Bags
E	Biogas Flame Arrestor	
F	Plumbing Accessories	Check Valves, Isolation Valves, Control Valves, etc
G	Shell & Tube Heat Exchangers	200 SS 304
H	Recycling Water Line	150 mm uPVC SH 40
I	Inspection Lids	Cast Iron
J	Burners	
K	Bucket Conveyor	
L	Solar Heater	
M	Small Incinerator for Non Recyclables	

6.3.3 Disposal by Modified Sanitary Landfill (MSLF)

Total wastes to be disposed of in MSLF = (Non-Degradable Waste part of A, B, C, D & E category (of Table – 13) waste per day	31.21 MT
30% of projected (final year) waste generation	35.10 MT
Maximum of above two	35.10 MT
Approximate Vol. of Solid Waste to be at Landfill site per day	70.20 CUM
Vol. of Solid Waste to be disposed off per year	25272.00 CUM
Assuming 52% compaction, compacted Vol. of Solid Waste	12130.56 CUM
It is recommended that the disposal will be done above ground level (area landfill) Let us consider that the total depth of MSLF is 25 M above GL. Earth cover 30 CM.	
So, Area required for yearly dumping	491.12 SQM
For 15 years required area will be	7366.74 SQM
Considering change in habits, increase land requirement by 10%	8103.41 SQM
Add service area @ 10%	8913.75 SQM

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or Area in Acres	2.20	Acres
Land requirement for Bio-gas plant	1.2	Acres
So, total land required for bio gas plant and sanitary landfill	3.40	Acres

The landfill site is to be operated in phases because it allows the progressive use of landfill area, such that at any given time a part of the site will have final cover, a part being actively field, a part being prepared to receive waste and a part is undisturbed.

In this case Landfill site area required to be develop in 3 phases each phase will be used for 5 years period; so area required for 5 years	2456	SQM
Cell size to be provided Length :	50	Mtr
Width :	20	Mtr
Contact Surface Area :	5256	SQM
Adding 30% extra for 5 years dumping :	6832.8	SQM

Linear will be provided on the contact surface area of the cell of each phase before the commencement of landfill operation. The cost of construction of linear for each phase (for 5 years dumping) has therefore been considered in the project cost.

Economics of the Project

Economics Based on Revenue Generation from Sorting of Recyclables

The Operation and Maintenance Cost and the Revenue Generation associated with Sorting and Sale of Recyclables are calculated and provided in the table below:

Table 6:

Economics for Sorting and Selling of Recyclables

Operation and Maintenance Cost per month		
Workers	30	Rs. 2,10,000
Supervisors	3	Rs. 42,000
Safety Equipments and Additional Accessories		Rs. 40,000
Total O&M Cost per month		Rs. 2,92,000
Revenue Generation per day		
Sale of Recyclables in MT	11	Rs. 88,000
Revenue generated per month		Rs. 26,40,000
Annual Revenue		Rs. 316,80,000

Economics Based on Revenue Generation from Sorted Waste

The plant can have potentially two end products besides the organic fertilizer. It can generate biogas or it can generate electricity (using this gas in a generator). The economic viability of both the options is listed separately.

Revenue generated using biogas as the final product

The table below shows the Revenue generated where Biogas is the final product

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Table 7:

Case I: End Product: Biogas	
Biogas Produced on Daily Basis:	1200 Kg
Revenue from Biogas sale	Rs. 30 per kg
Daily Revenue	Rs. 36,000
Monthly Revenue	Rs. 10,80,000
Annual Revenue	Rs. 129,60,000

Revenue Generation when Electricity is end product

Case II: Electricity		
Plant Generator Rating	100	Kwh/T
Hours of Operation	10	hours per day
Energy Produced Daily	4000	KWH
Excess Electricity for Sell:	3600	KWH
Unit Price for Sell:	7.5	per KWH
Daily Revenue	Rs. 27,000	
Annual Revenue	Rs. 81,00,000	

Table 8:

Waste generates around (8%) i.e.	3.2	MT Organic Fertilizer
Rate of Organic Fertilizer=	Rs. 3	/Kg
Revenue from Organic Manure=	Rs. 9,600	per day
Monthly Revenue =	Rs. 2,88,000	
Annual Revenue=	Rs. 34,56,000	

This additional revenue can be included to the above mentioned revenue alternatives, in case prospective buyers for organic manures are sourced.

Total Revenue Generation per Year = 31680000 + 8100000 + 3456000 = Rs. 432,36,000

Sustainability

The proposed biogas plant will generate Biogas and thus electricity along with some organic fertilizer on a daily basis. Each of these components generates predictable revenue for the duration of the plant operation. The main product is biogas that can be easily used for cooking and other applications. That can generate substantial revenue at the rate of Rs 30 to-60 per kg with a generation rate of 60 cubic meter of biogas per ton. In case the gas is converted to electricity, the state electricity board has to mandatorily purchase the electricity. The electricity generation rate is about 80 KWH per ton of solid waste. The organic waste also has a readily available market in the tea plantations or pineapple farms or other organic farming community. For every one ton of solid waste, about 60 to-80 kg of organic waste is generated and that can be sold for Rs 1 to 4 per kg. This revenue stream is reliable as the end product is easily transportable to the customers and has ready market. Therefore, once the plant is in operation,

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the plant can sustain its operation and maintenance cost purely based on the revenue. In reality, there will be some additional revenue also from recycle operation, but that is not being discussed in this section.

Viability analysis for both the options considered

Table 9:

Parameters	Case I: Biogas as the end product	Case II: Electricity as the End Product
Buyers	Hotels, Restaurants, Hospitals, etc	Buyers are easily available and Electricity can be sold to the SEBs or can be used by the Municipality.
Transport and Supply	Biogas needs to be transported in specialized storage trucks, from source to site.	Electricity can be directed to the customers through Transmission Line
Plant Machineries at Source	Biogas can be extracted directly from the Gas Balloons. The process will involve daily filling up of the trucks with biogas and delivery of the gases to the individual storage units with the customers. This has to be done daily while following all the appropriate risk management protocols associated with transportation and storage of explosive gases in pressure vessels in public areas.	On the other hand, for Electricity Generation, Generators, Gas Turbines and other accessories are required, along with transmission lines.
Operation and Maintenance	O &M Cost will involve maintenance of the vehicles and depreciation involved along with the salary of the driver and maintenance crew.	The O&M will involve some maintenance of the generators and gas cleaning equipment along with the depreciation of the equipment. The Generators depreciates with time. Thus more O & M Cost is involved
Economic Viability	It involves similar less Capital cost and yields slightly greater revenue	Capital cost is slightly higher, with similar revenue
Operational Risk	There is an inherent risk of an accident occurring during transportation and storage of the biogas in the pressure vessels either on the trucks or at the site of usage. That may happen with a road accident, or improper operation or any negligence. That may have some adverse impact on life and property over the long term. This will necessitate development and implementation of detailed risk management protocol by the Municipality	The entire system will be contained within the premises of the biogas plant and the electricity generated will be uploaded to the grid. Therefore there is no requirement of transportation of explosive gases on the public streets or storing gases in pressure vessels in public properties outside the site. Therefore, this alternative posses significantly less risk than the option of transportation of biogas as all risk is contained within the premises. Also, revenue collection is easier as revenue will be collected from a single source (Electric company)

Thus from the above table, generation and distribution of electricity is the safer alternative with an assured source of revenue. The daily operation is simple with minimum daily inputs.

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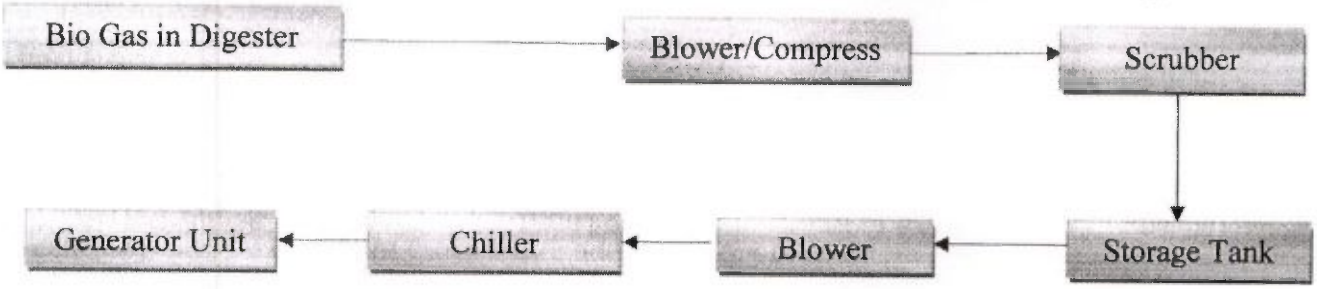
Bio-gas to Electric Generating Unit for 40 MT MSW Process Capacity Plant

The bio-gas generated from the waste in the main-digester is stored in tank located at site. The gas transferred to storage tank by a blower/compressor unit pass thru' a Scrubber. The bio-gas produced is generally have 30 to 35% of Carbon-di-oxide & 5 to 6% of moisture and some Hydrogen Sulphide which requires to be eliminated. This Scrubber works on elimination of these components. So a dry & pure bio-gas is transferred to the storage tanks.
This stored dry & pure bio-gas then drawn by a blower to pass thru' a de-humidifier cum chiller unit compatible to the process for conversion to electricity in the generator unit. Generally, 100 kWh power is generated from each MT of MSW processed. For 40 MT MSW process plant, 2 x 250 KVA generating unit is required to be installed to take care of the energy produced.

The schematic below shows the process flow for conversion of bio-gas to electrical energy :



The Digesters, Blower/Compressors for transfer gas to storage tank & the storage tank is a part of main process plant. To convert the output usage to generate electricity, The Scrubber unit, The Blower, The Chiller and the Generator units are to be added in the plant system and are to be integrated in-line with the schematic shown above.

Brief Specification:

A. Generator Unit:

Capacity	: 250 kVA, 3-phase
Fuel	: Bio-Gas
Engine Type	: 4 stroke, self-start, 1500/3000 RPM, SI engine
Power Factor	: 0.8
Engine Make	: Ashok Leyland / Equivalent
Alternator	: 200 kVA, Three/single phase, 415/230 Volts
Protection	: IP23
Sound Pressure Level	: 90 dB(A)
Cooling System	: Water Cooled

B. Scrubber cum Dehumidifier unit:

Capacity	: 65 m^3/hr
Pressure	: 50 – 100 mBar
Temperature	: Ambient
Gas-impurities to remove	: CO_2/CO, H_2S, SO_2, H_2O etc.
Scrubber type	: Chemical
Dehumidifier type	: Regenerative type bio-gas dehumidifier

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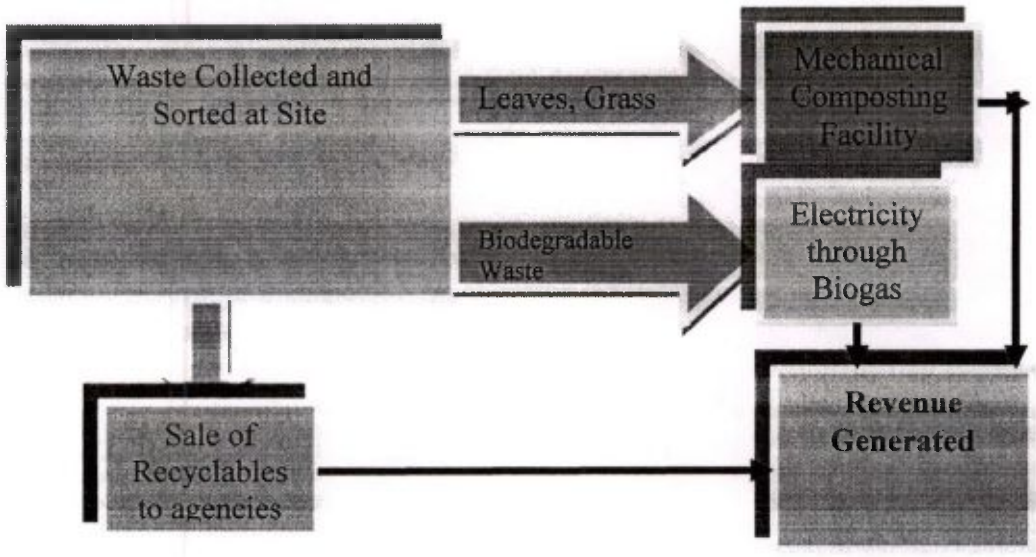
C. **Blower Unit:**

Capacity	: 337 m3/hr , 4.98 psig
Type	: twin-lobe
Motor rating	: 7.5 HP



Conclusion

The proposal intends to offer an integrated solution for Solid waste management for the Midnapur Area. The suggested alternative will create a regular sustainable solution in concern with "Zero Discharge" of waste along with generating electricity, thereby generating revenue on a regular basis.

Two revenue streams have been discussed; one with electricity and the other with fertilizer being generated on the daily basis.

The organic waste being generated (approximately 3 tons per day) also can be sold to the plantations and other entities interested in organic farming. The value for the organic waste has not been included in the payback analysis as the pricing for the end product is not clear for the surrounding market. However, once started, the project will certainly generate additional revenue from the fertilizer sales.

The cost for setting up the processing system including the initial capital cost for Land Development etc. is Rs. *1447.97* Lakhs and cost for Machinery and Equipments for Collection, Transportations and Disposal will be considered in the 2nd phase of the DPR and thus the City will gain revenue from the electricity sales, Organic fertilizers and some from the collection process.

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Basic Ward wise Information : MIDNAPUR MUNICIPALITY **Table - 10**

Ward No.	Area (sq. km.)	No.of Holdings	Population (2011)	Daily & Wholesale Market		Commercial centres		Hotels		Hospitals		Domestic Waste Collection System Followed	Market/ Commercial Waste Collection System Followed	Distance from the Dumping Ground (in Km.)
				No.	Appr. Quantity of Waste Generated (in mt)	No.	Appr. Quantity of Waste Generated (in mt)	No.	Total No.of Beds	No.	Total No.of Beds			
1		1246	7569	1	0.5							House to house collection	Community bin collection	4
2		1677	8476	1	1.5									4.5
3		1095	8785	1	1					2	32			2.5
4		1079	7312	1	1									3
5		1246	5376	2	1.5									3.5
6		1720	7725											3.5
7		1118	4733	2	1									3
8		1331	8201											3
9		1458	7356	2	1									2.5
10		2120	8023	2	1									2
11		474	4183											2
12		398	3726							3	767			2.5
13		571	5059											2.5
14		1064	7510											3
15		757	3759	2	1									3.5
16		1257	5839											4
17		1115	7933											3
18		1829	7586											2.5
19		977	5025											3
20		1570	7403	1	1									3.5
21		779	5414	1	2.5									4
22		1165	8543											4
23		1100	6949											4.5
24		785	8910	2	1									5
25		898	7732											6
Total	**18.36**	**28829**	**169127**	**18**	**14**	**14**	**5**	**33**	**245**	**5**	**799**		**Avg-**	**3.0**

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Table - 11

Wardwise Population as per Census Year - 2011	
Ward No.	**Population**
1	7569
2	8476
3	8785
4	7312
5	5376
6	7725
7	4733
8	8201
9	7356
10	8023
11	4183
12	3726
13	5059
14	7510
15	3759
16	5839
17	7933
18	7586
19	5025
20	7403
21	5414
22	8543
23	6949
24	8910
25	7732
Total	**169127**

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Table - 12

Growth Trend			
Arithmatic Increase Method			
Sl. No.	Year	Population	Increase in Population
	(1)	(2)	(3)
1	1971	71326	
			14836
2	1981	86162	
			38936
3	1991	125098	
			24691
4	2001	149789	
			19338
5	2011	169127	
	Total		97801

Average increase per decade (x) = $\frac{\text{Total increase in population}}{\text{Number of decades}}$

Hence, X = 97801 / 4

= 24450.25

Therefore, average rate of increase per decade with respect to population in the year of 2001,

x = 14.46 %

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Table - 13

Growth Trend				
Geometric Increase Method				
Sl. No.	Year	Population	Increase in Population	Percentage increase in population i.e. growth rate (r)
	(1)	(2)	(3)	(4) = Co. (3)/ Col. (1) x 100
1	1971	71326		
2	1981	86162	14836	14836/ 71326 x 100 = 20.8 %
3	1991	125098	38936	38936/ 86162 x 100 = 45.19 %
4	2001	149789	24691	24691/ 125098 x 100 = 19.74 %
5	2011	169127	19338	19338/ 149789 x 100 = 12.91 %

The geometric mean of the growth rate (r) = $(n-1)^{th}$ root of the multiplication of all 'r's

= (20.8 x 45.19 x 19.74 x 12.91) ^ 1/4

= 22.27

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Table - 14

Growth Trend				
Incremental Increase Method				
Sl. No.	Year	Population	Increase in Population in each decade	Incremental Increase i.e. increment on the increase
	(1)	(2)	(3)	(4)
1	1971	71326		
			14836	
2	1981	86162		24100
			38936	
3	1991	125098		-14245
			24691	
4	2001	149789		-5353
			19338	
5	2011	169127		
Total =			97801	4502

Average increase per decade (X) = 24450.25
and average of incremental increases (Y) = 1500.67

Therefore, average rate of increase per decade with respect to population in the year of 2001,

x = 14.46 %

and average rate of incremental increase per decade with respect to population in the year of 2001,

y = 0.89 %

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Table - 15

Computation of Design Population of Midnapore Town for different Design Years

Methods	Zone - All		
	Base Year	Intermediate Year	Final Year
	2019	2029	2039
Arithmetic Increase Method	188692	213148	237604
Geometric Mean Method	198641	242879	296968
Incremental Increase Method	189773	216930	245587
Average of the three Methods	**192369**	**224319**	**260053**

Total Design Population of the Town:

Base Year	**192369**
Intermediate Year	**224319**
Final Year	**260053**

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Table - 16

Computation of n values for different design years

Last known year	Future Year		Difference in years	Difference in decades (n)
(1)	(2)	(3)	(4)	(5) = Col. (4)/ 10
2011	Base year	2019	8	0.8
2011	Intermediate year	2029	18	1.8
2011	Final year	2039	28	2.8

Computation of zonewise Projected Population in different design years

Population in last known census year (P_0) (2011)			Arithmetic Increase Method				Geometric Mean Method				Incremental Increase Method			
			x(%)	$P_n = P_0(1+\frac{nx}{100})$			r (%)	$P_n = P_0(1+\frac{r}{100})^n$			x(%)	$P_n = P_0(1+\frac{nx}{100}+n(n+1)\frac{y}{100\times2})$		
Zone No.	Year	P_0 (2011)		Base Year	Intermediate Year	Final Year		Base Year	Intermediate Year	Final Year		Base Year	Intermediate Year	Final Year
				2019	2029	2039		2019	2029	2039		2019	2029	2039
All	14.46	169127	14.46	188692	213148	237604	22.27	198641	242879	296968	14.46	189773	216930	245587
											y(%)			
											0.89			
Total		169127		188692	213148	237604		198641	242879	296968		189773	216930	245587

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Table - 17

Projected waste generation			
Year	Projected Population	Projected waste generation as per Manual in MT	Projected waste generation considering present rate of the town in MT i.e. @0.45 kg/C/D
1	2	3	4
Base Year 2019	192369	40	87
Intermediate Year 2029	224319	47	101
Final Year 2039	260053	55	117

Conclusions:

1. As there are huge gap between manual provision and actual data collected from ULB(s) with respect to total generation of waste, the basic design is proposed considering present estimated genaration i.e.76 MT/Day except provision for sanitery land fill.
2. As the Bio gas plants are designed in modular manner hence another one or more module can be added as & when required. Provision of land for future expansion is earmarked.
3. Land for sanitery land fill is to be calculated on the basis of Final year generation of column 4 i.e. 30% of 117MT

Table 3.1 Quantity of Municipal Solid Waste in Indian Urban Centres

Population Range (in Millions)	Number of Urban Centres (sampled)	Total population (in Million)	Average per capita value (kg/capita/day)	quantity (tonnes/day)
< 0.1	328	68.3	0.21	14343.00
0.1 - 0.5	255	56.914	0.21	11952.00
0.5 - 2.0	31	21.729	0.25	5432.00
1.0 - 2.0	14	17.184	0.27	4640.00
2.0 - 5.0	6	20.597	0.35	7209.00
> 5. 0	3	26.306	0.50*	13153.00

* 0.6 kg/capita/day generation of MSW has been observed in metro cities

Source: Manual on MSW Management 2000

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Domestic Waste : MIDNAPUR MUNICIPALITY

Table - 18

Ward No.	Distance from the Dumping site (in KM.)	No. of Holdings	Population	Domestic Waste generate (in Kg.)	No. of Container (20 lit.) required	No. of Tyre-Mounted Wheel Barrow Required	Remarks
1	4	1246	7569	2081	125	25	In areas where house to house collection by wheel barrow will not be possible, combination of collection in community bin system and house to house collection by Wheel Barrow shall have to be adopted. Capacity of Community Bins - 200 lit.
2	4.5	1677	8476	2331	168	34	
3	2.5	1095	8785	2416	110	22	
4	3	1079	7312	2011	108	22	
5	3.5	1246	5376	1478	125	25	
6	3.5	1720	7725	2124	172	34	
7	3	1118	4733	1302	112	22	
8	3	1331	8201	2255	133	27	
9	2.5	1458	7356	2023	146	29	
10	2	2120	8023	2206	212	42	
11	2	474	4183	1150	47	9	
12	2.5	398	3726	1025	40	8	
13	2.5	571	5059	1391	57	11	
14	3	1064	7510	2065	106	21	
15	3.5	757	3759	1034	76	15	
16	4	1257	5839	1606	126	25	
17	3	1115	7933	2182	112	22	
18	2.5	1829	7586	2086	183	37	
19	3	977	5025	1382	98	20	
20	3.5	1570	7403	2036	157	31	
21	4	779	5414	1489	78	16	
22	4	1165	8543	2349	117	23	
23	4.5	1100	6949	1911	110	22	
24	5	785	8910	2450	79	16	
25	6	898	7732	2126	90	18	
TOTAL		**28829**	**169127**	**46510**	**2887**	**576**	

1 wheel barrow will covered about 50 to 75 holdings

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Trade Waste : MIDNAPUR MUNICIPALITY

Table -19

Ward No.	Area (sq. km.)	No.of Holdings	Population	Daily & Wholesale Market		Commercial centres		Hotels			Total Quantity of Waste Generated (MT)	Distance from the Dumping Ground (in Km.)
				No.	Appr. Quantity of Waste Generated (MT)	No.	Appr. Quantity of Waste Generated (MT)	No.	Total No. of Beds	Total . Quantity of Waste Generated (MT)		
1	0	1246	7569	1	0.5						0.50	4
2	0	1677	8476	1	1.5						1.50	4.5
3	0	1095	8785	1	1						1.00	2.5
4	0	1079	7312	1	1						1.00	3
5	0	1246	5376	2	1.5						1.50	3.5
6	0	1720	7725	0	0						0.00	3.5
7	0	1118	4733	2	1						1.00	3
8	0	1331	8201	0	0						0.00	3
9	0	1458	7356	2	1						1.00	2.5
10	0	2120	8023	2	1						1.00	2
11	0	474	4183	0	0						0.00	2
12	0	398	3726	0	0						0.00	2.5
13	0	571	5059	0	0						0.00	2.5
14	0	1064	7510	0	0						0.00	3
15	0	757	3759	2	1						1.00	3.5
16	0	1257	5839	0	0						0.00	4
17	0	1115	7933	0	0						0.00	3
18	0	1829	7586	0	0						0.00	2.5
19	0	977	5025	0	0						0.00	3
20	0	1570	7403	1	1						1.00	3.5
21	0	779	5414	1	2.5						2.50	4
22	0	1165	8543	0	0						0.00	4
23	0	1100	6949	0	0						0.00	4.5
24	0	785	8910	2	1						1.00	5
25	0	898	7732	0	0						0.00	6
TOTAL	**18.36**	**28829**	**169127**	**18**	**14.0**	**14**	**5.0**	**33**	**245**	**0.18375**	**19.2**	

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Clinical Waste : MIDNAPUR MUNICIPALITY

Table - 20

Ward No.	Area (sq. km.)	No.of Holdings	Population	Hospitals		Total Quantity of Clinic Waste Generated Daily (MT)	Total Quantity of infectious & hazardous Waste Generated Daily (MT)	Total Quantity of non-hazardous Waste Generated Daily (MT)	Total Quantity of hazardous & infectious Clinic Waste Generated in three days (MT)	Distance from the Dumping Ground (in Km.)
				No.	Total No. of Beds					
1		1246	7569							4
2		1677	8476							4.5
3		1095	8785	2	32					2.5
4		1079	7312							3
5		1246	5376							3.5
6		1720	7725							3.5
7		1118	4733							3
8		1331	8201							3
9		1458	7356							2.5
10		2120	8023							2
11		474	4183							2
12		398	3726	3	767					2.5
13		571	5059							2.5
14		1064	7510							3
15		757	3759							3.5
16		1257	5839							4
17		1115	7933							3
18		1829	7586							2.5
19		977	5025							3
20		1570	7403							3.5
21		779	5414							4
22		1165	8543							4
23		1100	6949							4.5
24		785	8910							5
25		898	7732							6
TOTAL	**18.36**	**28829**	**169127**	5	799	1.20	0.30	0.90	0.90	

There are 41 Nos. Private Clinic, 150 nos. Pathological Laboratories. Total quantity of waste generated from those establishment will be about 1000 kg.

Note: i) Assumed that Clinical Waste generated @ 1500 gm per bed. ii) 25 % of the Clinical Waste generated is infectious in nature

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Estimation of Total Waste Generation Per Day in the Town

Table - 21

Category	Generation Points	Total (in kg.)	Quantity of Waste (in Kg.)		Remarks
			Waste Type		
			Bio-degradable	Non-degradable	
A	Domestic	46510	27906	18604	To be transported to Bio Gas / Compost plant site except the non-degradable portion of domestic and hotel waste
	Daily & Wholesale Market	14000	11200	2800	
	Hotels	184	74	110	
	Agricultural/ Garden	700	700	0	
	Sub-total	61394	39879	21514	
B	Commercial Centres	5000		5000	To be transported to land fill Site
	Railway Station	1000		1000	
	Bus Stand	500		500	
	Sub-total	6500		6500	
C	Street Sweepings	1000		1000	do
	Drain Cleanings	1000		1000	
	Sub-total	2000		2000	
D	Cess pool	4500	4500		To be transported to trenching site
E	Clinical	1199		1199	To be transported to secured burial site
	Total	75592	44379	31213	

Note:

i) Domestic SW contains about 60% organic matter and remaining 40% is inert materials
ii) Moisture content in organic waste is about 50%
iii) Hotels generate SW @750gm/bed and contains about 50% organic matter and remaining 50% is inert materials
iv) Market SW contains about 80% bio degradable matter and remaining 20% is inert materials
iv) Assumed that trade waste contains about 10% bio degradable matter and remaining 90% is inert materials
v) Assumed that Agricultural waste contains about 100% bio degradable matter neglecting the very few inert materials
vi) In hospital waste
a) Infectious & hazardous waste is 0.300 MT
b) Non-hazardous waste is 0.899 MT

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ABSTRACT COST ESTIMATE (PHASE-I)

Development of Land Fill Site & Processing Plant

Table - 22

Sl. No.	Particulars	Amount (Rs. in lakh)
1	Development of Land Fill Site	213.56
2	Construction of Bio-gas Plant	1192.23
	Total	**1405.79**
	Contingencies @ 3%	42.17
	Grand Total	**1447.97**

Cost of Development of LandFill Site

Table - 22A

SL. NO.	PARTICULARS	AMOUNT Rs. (in lakh)
1	Renovation of Approach Road to landfill site 500 mt. length width 5.5m. @ Rs. 1500 per m.	7.5
2	Site Development	25.0
3	Grass covering over existing dumped waste	91.1
3	Cost of providing linear (for 5 years dumping)	15.0
4	Construction of protection wall (CRM)	20.0
5	Construction of surface run-off diversion drain	20.0
6	Construction of leachate circulation & treatment system at Landfill site	30.0
7	Tree plantation	2.0
8	Construction of Site Office	3.0
	TOTAL	213.56

Estimate for Grass Covering

Table - 22A(i)

Area: 3 acres
12138 sq m

Height 10 m

Item	Unit	Quantity	Rate	Amount (in Rs.)
Waste Backfill	cu.m	60690	59.49	3610448.10
Compacted clay	cu.m	3641.4	237.96	866507.54
Leachate collection Pipe	m	100	298.00	685400.00
Grass tiles	sq.m	18207	203.43	3703850.01
Gas Extraction Vents	m	500	120.00	240000.00
Total				**9106205.65**

Estimated Cost for Bio gas Plant

Table - 22B

Sl No.	Item	Cost (in Rs.)
1	Civil Cost	**28,892,134**
2	Mechanical	**62,773,849**
3	Gas storage	**6,264,100**
4	Sorting facility	**21,292,960**
	TOTAL (Rs.)	**119,223,043**

Total Solid Waste Generated	76 MT
Total Tonnage of Bio- Degradable waste	**44.38** MT
Total Tonnage to be Processed	40.00 MT
Recommended layout:	8 Units @5 MT/Units
Total System tonnage	**40 MT**

Table - 22B(i)

ESTIMATE OF CIVIL WORK FOR 70 MT FOUNDATION AND COLUMNS ,BEAMS; SLABS FOR PROP. BIOGAS LAYOUT						
Sl. No	Description	Page Ref	Quantity	Unit	Rate (in Rs.)	Amount (in Rs.)
1	Earth work in excavation of foundation trenches or drains, in all sorts of soil (including mixed soil but excluding laterite or sandstone) including removing, spreading or stacking the spoils within a lead of 75 m. as directed. The item includes necessary trimming the sides of trenches, levelling, dressing and ramming the bottom, bailing out water as required complete. (a) Depth of excavation not exceeding 1,500 mm.	BUILDING WORKS 2015 P-1 It-2.a	1720.00	m3	120.47	207,208
2	Earth work in filling in foundation trenches or plinth with good earth, in layers not exceeding 150 mm. including watering and ramming etc. layer by layer complete. (Payment to be made on the basis of measurement of finished quantity of work) (a) With earth obtained from excavation of foundation	BUILDING WORKS 2015 P-1 It-3 a	346.67	cu.m	78.31	27,147
3	Ordinary Cement concrete (mix 1:2:4) with graded stone chips (20 mm nominal size) excluding shuttering and reinforcement,if any, in ground floor as per relevant IS codes. a) Pakur Variety	BUILDING WORKS 2015 P-12 It-5.a	167.19	cu.m	6,107.38	1,021,063
4	Ordinary Cement concrete (mix 1:1.5:3) with graded stone chips (20 mm nominal size) excluding shuttering and reinforcement if any, in ground floor as per relevant IS codes (i) Pakur Variety	BUILDING WORKS 2015 P-15 It-7.i	1816.55	cu.m	6,845.46	12,435,145
5	Hire and labour charges for shuttering with centering and necessary staging upto 4 m using approved stout props and thick hard wood planks of approved thickness with required bracing for concrete slabs, beams and columns, lintels curved or straight including fitting, fixing and striking out after completion of works (upto roof of ground floor) (c) Steel shuttering or 9 to 12 mm thick approved quality ply board shuttering in any concrete work	BUILDING WORKS 2015 P-27 It-12.c	8931.02	sq.m	403.00	3,599,200
6	125 mm. thick brick work with 1st class bricks in cement mortar (1:3) in ground floor	BUILDING WORKS 2015 P-32 It-30	3733.98	sq.m	810.00	3,024,526
7	Reinforcement for reinforced concrete work in all sorts of structures including distribution bars, stirrups, binders etc initial straightening and removal of loose rust (if necessary), cutting to requisite length, hooking and bending to correct shape, placing in proper position and binding with 16 gauge black annealed wire at every intersection, complete as per drawing and direction. I. SAIL/ TATA/RINL	BUILDING WORKS 2015 P-28 It-15.1	97.09	MT	69,483.00	6,746,316
8	Plaster (to wall, floor, ceiling etc.) with sand and cement mortar including rounding off or chamfering corners as directed and raking out joints including throating, nosing and drip course, scaffolding/staging where necessary (Ground floor).[Excluding cost of chipping over concrete surface] (iii) With 1:3 cement mortar (b) 15 mm thick plaster	BUILDING WORKS 2015 P-164 It-2.iii.b	8414.51	sq.m	188.00	1,581,927
9	Neat cement punning about 1.5mm thick in wall,dado,window sill,floor etc. NOTE.Cement 0.152 cu.m per100 sq.m.	BUILDING WORKS 2015 P-166 It-8	6568.42	sq.m	38.00	249,600
Total						**28,892,134**

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RATE ANALYSIS OF CEMENT CONCRETE ITEMS

Railway Yards Midnapore

Type of Concrete Ordinary Cement concrete (mix 1:2:4)

Zone All district except hill area of Darjeeling

District Medinipur (W)

Work Site : **Midnapur**

Distance from Midnapore Rly yard to Midnapur work site = 10.00 KM

Say, 10.00 KM

Sl No.	Description	Volume cum.	Rate	Amount
1	5(a) Ordinary Cement concrete (mix 1:2:4) Pakur Variety			4352.00
2	Rates of Pakur variety stone aggregates at Midnapore Railway yards [Table : T-1, p-1]			
	20 mm Nominal Size	0.660	1800.00	1188.00
	10 mm Nominal Size	0.220	1633.00	359.26
3	Road carriage from Midnapore RLY yeard to work site = 10 KM			
	Carriage upto 5 Km. = Rs. 124.00			
	From 5 to 10 Km. @ 10.90Km. = Rs. 54.50			
	Total Carriage Cost **Rs. 178.50**	0.88	178.50	157.08
4	Loading & Unloading *[TABLE :T-3]*	0.88	58.00	51.04
	Total Cost at Site per Cum.			**6107.38**

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RATE ANALYSIS OF CEMENT CONCRETE ITEMS

Railway Yards Midnapore

Type of Concrete Ordinary Cement concrete (mix 1:1.5:3)

Zone All district except hill area of Darjeeling

District Medinipur (W)

Work Site : **Midnapur**

Distance from Midnapore Rly yard to Midnapur work site = 10.00 KM

Say, 10.00 KM

Sl No.	Description	Volume cum.	Rate	Amount
1	7(a) Ordinary Cement concrete (mix 1:1.5:3) Pakur Variety			5142.00
2	Rates of Pakur variety stone aggregates at Midnapore Railway yards [Table : T-1, p-1]			
	20 mm Nominal Size	0.573	1800.00	1031.40
	10 mm Nominal Size	0.287	1633.00	468.67
3	Road carriage from Midnapore RLY yeard to work site = 10 KM			
	Carriage upto 5 Km. = Rs. 124.00			
	From 5 to 10 Km. @ 10.90Km. = Rs. 54.50			
	Total Carriage Cost **Rs. 178.50**	0.86	178.50	153.51
4	Loading & Unloading *[TABLE :T-3]*	0.86	58.00	49.88
	Total Cost at Site per Cum.			**6845.46**

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Table - 22B(ii)

ESTIMATE FOR ELECTRO-MECHANICAL

Item	Specification	Qty	Rate (in Rs.)	Amount (in Rs.)
Blower	337 m3/hr , 4.98 psig, 7.5 hp	10	108,376	1,083,760
Mixer	800 kg/hr, 10 hp	10	402,960	4,029,600
Sludge Pump	50 m3/hr, 26 mtr head, 7.5 hp	10	52,677	526,770
Solar Panel	650 litres, 7ft x 14 ft with 3 kw heater	8	168,015	1,344,120
Compressor	23 CFM, 8.5 kg/cm2 , 5 hp	10	93,628	936,280
Generator Set	200 KVA	3	3,991,200	11,973,600
Generator Auxileries (scrubbers, dehumidifiers etc.)	For electricity	3	2,410,320	7,230,960
Piping	AS PER REQ	LUMPSUM	6,500,000	6,500,000
Steel Tank	Per Kg	160,308.05	135	21,641,586
Installation for Fabrication (Scaffolding incl of Labour)			300,000	300,000
Gas Burner	BIOGAS	4	8,500	34,000
Gas Meter	BIOGAS	11	22,655	249,205
pH Meter		4	8,832	35,328
Electricals		LUMPSUM	2,500,000	2,500,000
Protective Coating	GLASS EPOXY COATING	LUMPSUM	2,400,000	2,400,000
Transportation	of steel plates		300,000	300,000
Shed for equipment building (sq.ft)	Steel structure	3443.2	200	688,640
Small Incinerator		2	500,000	1,000,000
			Total	**62,773,849**

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Weight of steel tanks

	Main Digester	Pre Digester 1		
A. Base Plate				
Dia (mtr)	8.5	5.5		
Thickness (mtr)	0.006	0.006		
Metal Volume (m3)	0.3	0.1		
Steel weight (kg)	**2,672.69**	**1,119.02**		
B.Shell Plate				
Dia (mtr)	8	5		
Height (mtr)	4.5	4.5		
Thickness (mtr)	0.005	0.005		
Metal Volume (m3)	0.6	0.4		
Steel weight (kg)	**4,439.07**	**2,774.42**		
C.Baffle Plate				
Av. Width (mtr)	5.33	5		
Height (mtr)	3.5	3.5		
Thickness (mtr)	0.005	0.005		
Numbers	3	1		
Metal Volume (m3)	0.3	0.1		
Steel weight (kg)	**2,198.00**	**686.88**		
D.Roof Plate				
Dia (mtr)	8.5	5		
Thickness (mtr)	0.005	0.005		
Metal Volume (m3)	0.3	0.1		
Steel weight (kg)	**2,672.69**	**924.81**		
E.Dome shell				
Dia (mtr)	8.5			
Height (mtr)	0.8			
Thickness (mtr)	0.005			
Metal Volume (m3)	0.1			
Steel weight (kg)	**838.49**			
E.Stiffener wt. & other	**1,059**	**654**		
Total Steel wt	**13,879.60**	**6,158.90**		

Total Steel wt of one set of pre & main digester	**20,038.51**
No. of units	8

Total project weight of steel for pre & main digester tanks **160,308.05**

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MECHANICAL ITEMS

Sl No.	Item	Brief Spec	Basic rate per unit	P&F, Taxes & duties, Transportation and loading-unloading etc.	Total material cost to site	Cost of erection & commissioning	Contingency, adminisrative , Finance & margin	Total budget	Vendor
1	Blower	337 m3/hr , 4.98 psig, 7.5 hp	67000	19740	86740	7500	14136	108376	ROOTECH
2	Mixer	800 kg/hr, 10 hp	280000	60400	340400	10000	52560	402960	SMART
3	Sludge Pump	50 m3/hr, 26 mtr head, 7.5 hp	36700	8106	44806	1000	6871	52677	DEBSON
4	Solar Heater	650 litres, 7ft x 14 ft with 3 kw heater	120000	24100	144100	2000	21915	168015	INSILiCA
5	Compressor	23 CFM, 8.5 kg/cm2 , 5 hp	66878	13038.04	79916.04	1500	12212	93628	ZENTECH
6	Generator Set	250 KVA	2800000	516000	3316000	10000	665200	3991200	URJA
7	Auxiliaries of generator system	Scrubber, Dehumidifier & blower	1840000	341200	2181200	10000	219120	2410320	URJA
8	Gas Meter		15000	4450	19450	250	2955	22655	ST Instruments
9	pH Meter		6000	1680	7680		1152	8832	ST Instruments

Conveyor system for sorting Platform area

10	Conveyor	2	11520000	2153600	13673600	800,000.00	2171040	16644640	DRB Engineering

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Table-22B(iii)

FACILITY OF GAS STORAGE & SORTING PLATFORM

Gas Storage facility			
Volume of gas generated:	2400	cum	at 1 UNIT
The Tank Pressure	5	kg/cm2	
The volume of tank	480	cum	
Diameter of tank:	5	m	
Area	19.625	sq m	
Ht of tank	24.46	m	
Wall thickness	0.01	m	
Volume of steel on sides:	3.84	cum	
Volume of two ends	0.3925	cum	
Total Volume:	4.2325	cum	
Wt of tank	31320.5	kg	
Fabrication, valving etc cost:	200	per kg	
Total cost of gas storage facility	**6,264,100.00**		

Table-22B(iv)

Sorting Facility

Sorting platform structural & flooring	2582.4	sq ft	4,648,320.00
Conveyor system with bucket elevator			16,644,640.00
	Total		**21,292,960.00**

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Table - 23(i)

Operation and Mainetenance Cost for Biogas plant

Categories	Unit	Quantity	Rate	Expenses Per Month
A. Labour				
1.Bio Gas Operators	no	8	8,000.00	64,000
2. Supervisor	no	2	12,000.00	24,000
3. Chemist	no	1	15,000.00	15,000
4. Administration Charges	Lump sum			5,000
5. Regular visit charges of technical experts for technical support	Per Visit	1 per 2 month	10,000.00	5,000
Sub-Total for Manpower on Monthly Basis				113,000
B. Ancillary Items				
1. Upkeep & maintenance charges. (Apron, hand gloves, mask, gumboot, cap, phenyl, liquid soap, soap, duster, hard broom, soft broom, first aid kit, spade, water pipe.	Lump sum			25,000.0
2. Repairs & replacement of machinery parts, changing of oil and mixer and compressor belts.	Lump sum			15,000.0
3. Miscellaneous	Lump sum			5,000.0
Sub-Total for Ancillary Items				45,000.0
C. Electricity				
Average projected Electricty consumption is 10 KWH per ton	kwh	400.00	6.00	72,000.0
Monthly cost				230,000.0
Total Operation & Maintenance Cost per Year				**2,760,000.0**

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Table - 23

O & M COST FOR LAND FILL, BIO-GAS & SORTING & SELLING OF RECYCLABLES

SL.NO.	PARTICULARS	AMOUNT PER MONTH (Rs.)	AMOUNT PER YEAR (Rs.)	Remarks
3	O & M cost for Landfill Operation	17797	213562	
4	Labour cost for bio-gas composting	230000	2760000	
5	Cost for Sorting and Selling of Recyclables	292000	3504000	
8	Cost of consumables	5000	60000	LS
9	Cost of energy	5000	60000	LS
10	Marketing Expenses	50000	600000	LS
11	Miscellaneous	10000	120000	LS
	TOTAL	**609797**	**7317562**	
		Say Rs.	**73.18**	**lakh**

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RECOMMENDATIONS

PROPOSED SOLID WASTE MANAGEMENT SYSTEM
FOR
MIDNAPUR MUNICIPALITY

Procedure to be followed by Midnapur Municipality

1) SEGREGATION OF MUNICIPAL SOLID WASTES

- Segregation of Bio-degradable & non-degradable wastes should be done at source. However a sorting operation also to be done before feeding Bio-gas plants to ensure smooth functioning.
- This should be made possible by vigorous awareness Campaign and by group meetings in each Ward, announcements, leaflets etc. prior to launching of the project and thereby ensuring community participation. Ward level S.W.M. Committees should be the instrumental in this matter.
- Provide two polythene containers, preferably not suitable for storage of liquid, one is **Green** another is **Yellow** to each family for collection of **bio-degradable SW and non-degradable SW respectively.**

(***The containers shall be supplied by the Municipality once only. Replacement of the containers if required subsequently shall be arranged by the individual occupiers of the holdings themselves. For convenient Municipality may arranged to sale those containers to the tax-payers)***

- Segregation of Bio-medical wastes should be done as per prescribed rules.

{*Note*: **Bio-degradable SW means which are basically organic in nature and biologically degradable which includes kitchen waste, fruit & vegetable waste, food waste, leaves & trees, agricultural waste, discarded cloths, papers, wood etc. and non-degradable SW are basically inorganic in nature and biologically not degradable it includes plastic & PVC items, PET Bottles, metal & metal foils, ashes, cinders, stones, bricks etc.**}

2) COLLECTION OF MUNICIPAL SOLID WASTES

- Each ward should be divided into 2 & 3 beats comprising of 175 – 200 waste generating points which include Domestic units, Shops, Hotels & Restaurants and other Commercial Establishments.
- For ach beat there should be one Collector and a lady Supervisor for the whole ward i.e. for two or three beats.
- One Wheel Barrow or Three wheeled Motor Van may be provided for 2 or more beats as per the requirement.
- Solid wastes shall have to be collected every day between 7 a.m. to 10 a. m. by the Collectors by blowing whistle. Segregation of bio-degradable and non-degradable wastes are to be done at source.

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- Each residential /domestic unit should be provided with two containers – one for bio degradable wastes and the other for non bio-degradable wastes in **Green & Yellow** containers respectively. Wastes from those containers should be collected in separate bins on the wheel barrows.
- For house to house collection of solid waste involvement of NGO's is to be encouraged. Persons from BPL families of that locality or near by localities may be involved for house to house collecting of solid waste.
- They may be allowed to collect Rs. 30/- from APL families to Rs. 10/- from each BPL family for house to house collecting of solid waste. All implements for collection of solid waste should be provided by the municipal authority. (This will not only reduce the cost of collection on the part of civic body but will also ensure effective and efficient cleaning system.)
- Uprooted plants, grass and cut branches of trees and leaves should be collected separately.
- After collection the solid waste it should be carried to transporting vehicle posted at transfer stations.
- Bio-degradable wastes and non-degradable wastes should be transported separately by covered vehicles.
- By 2 p.m. each day the bio-degradable wastes are to be carried to the composting site and the trailers/Compactors with non-degradable wastes are to be carried to the landfill sites for disposal.
- The whole operation is to be monitored by Ward level Solid Waste Management Committees specially formed jointly by public and Municipal Administrators
- Littering of wastes in streets and drains shall have to be stopped by providing litter bins at suitable locations.

3) STORAGE OF MUNICIPAL SOLID WASTES

- Solid Wastes is to be stored by the waste generators in two separate bins of different colour provided for them by the Municipality and that should be collected within 24 hours.
- Storing of wastes in Vats or dumping by the road side should be prohibited. Road side Vats should be gradually turned into flower or plant pots. Where house to house collection is not possible Community bin collection method is to be adopted.
- After collection of solid waste it should be taken straight to the waiting trailers / Dumpers / truck at transfer stations.
- Colour Codes of Collection bins and trailers should be strictly followed.

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4) TRANSPORTATION OF SOLID WASTES

- From waste generating points waste should be transferred to the transfer stations i.e two wheeled refuse trailers /Dumper or covered truck by specially designed Wheel Barrows. The vehicles either should have to compartments each for bio-degradable and non-degradable waste or there should be separate vehicles for bio-degradable and non-degradable waste for transportation.
- **Compactors to be used for non-bio degradable wastes.**
- Raised platforms i.e. ramp are to be built for hauling of wheel barrows / bins up to the height of transfer stations to make collection cleaner and to avoid multiple handling of Waste.
- Transfer stations should be carried by the prime movers straight to the sites in a train within 2/3 hours.

5) PROCESSING OF WASTES

- Bio-degradable wastes mainly Kitchen trash, market wastes comprising of vegetables wastes, fish etc. should be processed through 8 Nos. Bio-Gas Plant of capacity 5 MT each. Bio gas plants may be installed in phases as under:

Expected quantity of Bio-Degradable Waste	No. of 5 MT Bio-gas plant to be installed in 1st Phase	No. of 5 MT Bio-gas plant to be installed in 2nd Phase
40 MT	4	4

- The organic waste being generated (approximately 5 tons per day) also can be sold to the plantations and other entities interested in organic farming. The value for the organic waste has not been included in the payback analysis as the pricing for the end product is not clear for the surrounding market. However, once started, the project will certainly generate additional revenue from the fertilizer sales.

Packaging and Marketing of Bio-Fertilizer

The bio-fertilizer produced should be sent to the market in good packaging and market the same by creating a Brand Name of the product. Appropriate efforts are to be given for enhancing for the brand value. Packaging should be made in five kg. twenty kg. and fifty kg. containers. Dealers and distributors' network is to be developed in the nick market. Good marketing strategy and product placement will definitely fetch a good revenue to the Municipalities.

6) DISPOSAL OF MUNICIPAL SOLID WASTES

- Non-degradable, inert wastes are to be carried daily in the landfill site.

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- After the expiry of life time the landfill site in future will be use for floriculture.
- Bio-medical Solid wastes should be disposed of in accordance with the bio-medical wastes. (Management & Handling Rules, 1978).

7) MANAGEMENT REGULATIONS FOR SOLID WASTE DISPOSAL AND RECYCLING ISSUED BY THE MUNICIPAL LEVEL SOLID WASTE MANAGEMENT COMMITTEE

Management Regulations relating to solid waste disposal and recycling should be adopted by the Midnapur Municipal Board after exhaustive discussion with all concerned and the board of councilors meetings in due time.

8) ADMINISTRATION

Institutional Strengthening & Human Resources Development

It is necessary to provide adequate training to all the levels of staff engaged in SWM services. The lower level staff such as sweepers, sanitation supervisors up to the level of Sanitary sub-inspectors should be given training locally in various aspects like storage, segregation of waste and primary collection of waste etc. whereas the sanitary inspectors and above may be given training in modern technologies of waste management, transportation, planning, personnel management programme within and outside the city or state. The senior officers of SWM department should be given adequate training through workshops and visits to various parts of the country and abroad.

Decentralization of Administration

SWM services can be performed effectively only if its administration is adequately decentralized. The decentralization can be at least 3 tiered- one at the Ward level, second at the Zone level, third at the city level. **For creating a competitive environment in regard to performance of SWM systems "Cleanliness Awards" should be given each year to the best performing ward(s).**

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SW MANAGEMENT SYSTEM AT MUNICIPAL LEVEL

Level	Responsible for
Ward level	Awareness Campaign, Motivation, Collection of waste
Zonal level	Transportation of waste, Training & capacity building of the staff
City level	Processing, disposal & overall management, Research Development & Upgradation

a. Ward Level Administration

The ward level administration should be fully responsible for ensuring storage of segregated waste at source, primary collection of waste, street sweeping and taking the waste to the bulk community waste storage site etc. The cleaning of each street, lane, by lane, markets, etc. should be regularly supervised by the ward level supervisors. Presence of all SWM officers of the Ward in the field during morning hours is most essential. Besides grievance re-dressal system has to be in place in each ward.

b. Zonal Administration

Administrative zones may be made for a group of wards. The zonal administration should effectively supervise and support the work of the ward administration and also provide zonal level support such as construction and upkeep of flooring under the communal waste storage sites transportation of waste from the communal storage sites to the transfer station, processing plant or to the disposal sites as may be determined by the local body. If the zones are not allotted adequate vehicles for the transportation of waste due to paucity of vehicles, the transportation of waste may be coordinated centrally for the optimum utilization of the fleet of vehicles in 2 or 3 shifts.

c. City Level Administration

The city level administration should emphasis on Monitoring of the System Training & capacity building of the staff. It will keep liaison with the zone level administration for periodical review of the operation of the system and take necessary support from it.

The city level administration should supervise and support the zone administration and in cases where the fleet of vehicles is not decentralized at the zone level, the central SWM Department should look after the transportation of waste from the community waste storage sites on a daily basis. The Central SWM Department should be responsible for construction and upkeep of transfer stations, setting up and maintenance of processing plants, incineration plants and vehicles as well as for managing the disposal of waste at the landfill sites in an environmentally acceptable manner. The central level administration should run the operation of the workshop for repairing of solid waste management vehicles and other

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accessories. It will also maintain the **vehicles like, Road Sweeping Machine-1, Tractor-1, Ordinary Truck -2** and will deploy those vehicles as and when required at various zones.

The central SWM department should also be responsible for the procurement of vehicles, equipment and land for processing and disposal of waste. As a head office it should take policy decisions and co-ordinate the activities of all the zones and the wards and be answerable to the Chief Executive and elected body for the efficient functioning of the department. It should look after the recruitment of manpower, human resources development, training etc.

d. Interactive Meets And Communication

State Governments should organize interactive meets for the subordinate officers in charge of SWM in various local bodies for exchange of information and sharing of experiences.

9) CREATION OF PLANNING & MONITORING UNIT

The provision of SWM infrastructure like waste collection, temporary storage, transfer, processing and disposal of waste should be made mandatory pre condition in urban planning.

So there should be a continuous planning and monitoring activity for solid management programme. A planning and monitoring unit **headed by a person having qualification and experience in Public Health Engineering** under the control of **Municipal Engineering Directorate, Department of Municipal Affairs, Govt. of West Bengal** should be created to perform this activity. The planning and monitoring unit should analyze and compare the standards, perform the environmental impact assessment, recommend various level of mechanization and labour involvement needed and feed back the analyzed data to the municipalities as well as Govt. for implementations and / or modification of the system. This unit will also monitor the production and quality control compost manure and also render necessary help for marketing the product for the municipalities. This unit will also monitor the production and quality control of compost manure, render necessary help for marketing the product for the municipalities by creating a common brand name and enhancing brand value through advertisement, establishment of dealers network for all the manures produced in different municipal towns of WB.

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PROPOSED SOLID WASTE MANAGEMENT SYSTEM
DIRECTIVES FOR PROPER SURVEILLANCE AND SUSTAINABILITY

DOMESTIC SOLID WASTE

- Domestic Solid Waste is to be accumulated in individual premises in two separate containers; Bio-degradable SW in Green container and the non-degradable SW in Yellow container.
- Collect the two types of domestic SW daily in Wheel Barrow. Each Wheel Barrow should have four containers for bio-degradable and four non-degradable wastes of capacity 20 ltrs.
- Transfer the waste from Wheel Barrow to transportation vehicles kept at transfer stations. Each transfer station shall have a ramp of suitable height and slope for transferring the waste from Wheel Barrow to standing transportation vehicles directly (see fig given).
- Transport Bio-degradable SW to Composting Plant by covered vehicle. Transport non-degradable SW to sanitary LandFill Site by covered vehicle.
- Compost the Bio-degradable SW by the combination of Windrow Method and vermi composting.
- Dispose off the Residue from Compost Plant to LandFill site.
- Extract the recyclable materials from non-degradable SW.
- Dispose the residual non-degradable SW to LandFill site.

MARKET SOLID WASTE

- Market Solid Waste (SW) is to be accumulated in bins located at a suitable place convenient for the smooth movement of transportation vehicle.
- Transport SW to Composting Plant by covered Vehicle as stated above in domestic waste.
- These markets produce large volumes of solid waste. Depending on the size of the market, the local body shall provide large size containers with lid or skips for the storage of market waste at suitable locations within the market.
- The shopkeepers shall not dispose of their waste in front of their shop / Establishment or anywhere on the street or open spaces and instead shall deposit their waste as and when generated into the large size container that may be provided for the storage of waste in the market.

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- Compost the Market Waste by Windrow Method.
- Dispose the Residue from Compost Plant to Land Fill site.

WASTE FROM TRADE AND COMMERCE

- Waste from trade and commence in CBD (Central Business District) is to be collected by Wheel Barrow or by Wheel Barrow twice a day at suitable time.
- Business Houses are to be directed to dispose off their waste either to the door to door collecting vehicles or to the community bins at particular time in a day.
- Waste from trade and commerce is to be accumulated in Vats located at a suitable places.
- Transport SW to sanitary LandFill Site by covered Vehicle.
- Extract the recyclable materials from SW.
- Dispose the residual of waste to Landfill site.

DIRECTIVES TO HOTELS & RESTAURANTS

All hotels and restaurants may be directed that: -

- Hostels and restaurants shall refrain from throwing their dry and wet solid waste / sweeping on the footpath, streets, open spaces etc.
- They shall also refrain from disposal of their waste into the municipal bins. They shall organize their own door step collection system or have this facility through ULB on full cost-recovery basis.
- They shall store their waste into sturdy metal HDPE / LDPE / Plastic or any other type of container having tight lid and no sharp edges. The container should have appropriate handle and rim at the bottom. The size of each container should not exceed 60 liter for easy handling of waste.

DIRECTIVES TO VEGETABLE / FRUIT MARKET SHOP OWNERS

- These markets produce large volumes of solid waste. Depending on the size of the market, the local body shall provide large size containers with lid or skips for the storage of market waste at suitable locations within the market.
- The shopkeepers shall not dispose of their waste in front of their shop / Establishment or anywhere on the street or open spaces and instead shall deposit their waste as and when generated into the large size container that may be provided for the storage of waste in the market.

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DIRECTIVES TO MEAT AND FISH SHOP OWNERS

- The shopkeepers shall not throw any waste in front of their shops or any where on the streets or open spaces.
- They shall keep sturdy containers (of size not exceeding 60 liters) having lid, handle and rim at the bottom of the container with adequate spare capacity to handle unforeseen loads.

DIRECTIVES TO STREET FOOD VENDORS

- All street food vendors may be directed not to throw any waste on the street or pavement. They must keep bins for the storage of waste that generate during their activity.

DIRECTIVES FOR CONSTRUCTION & DEMOLITION WASTES

- No person should be allowed to dispose of construction waste / debris on the streets / open space / foot path or pavement etc.
- Construction waste shall be stored until removed only within the premises of the building or in containers where such facility to renting out containers is provided by the local body. In exceptional cases such waste may temporarily be stored till a specified date on public or private land with prior written permission of the Govt. or local authority.
- The local body shall prescribe the rate per M.T on for the collection, transportation and disposal of construction waste / debris and notify the same to the people.
- Every person who is likely to produce construction waste shall deposit with the local body an approximate amount in advance at the rates as may be prescribed by the local body from time to time for the removal and disposal of construction waste from his premises by the local body.
- Such amount shall be deposited at the time when the building permission is being sought and in cases where such permission is not required, at any time before such waste is produced.
- The charges for removal of construction waste to be kept double for those who fail to deposit the amount in advance.
- Local bodies may make an endeavor to provide the facility of skips / containers on rent for the storage and transportation of construction waste.

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DIRECTIVES FOR INDUSTRIAL WASTES

- No industry should be allowed to dispose of its waste on the streets / open space or any other place without the permission of local body.
- Industrial waste shall be stored until removed only within the industry premises.
- The waste should be stabilized according to the nature of the waste before it is disposed of.
- Authorized agencies engaged by the industry/industries and approved by the local body shall transport and dispose of the industrial waste at sanitary landfill site of industrial waste as per the prescribed norms and procedure. The rate per MT on for the collection, transportation and disposal of Industrial waste shall be fixed by the mutual agreement between the industries and the authorized agencies for disposal of industrial waste.
- If the land is provided by the Municipality then user charge should be recovered from the industries as well as the Authorized agencies.
- Local bodies may make an endeavor to provide the facility of skips / containers on rent for the storage and transportation of industrial waste on user charge basis.

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Directives to Hospitals / Nursing Homes / Pathological Laboratories / Health Care Centers / Establishments etc.

- These establishments produce bio-medical as well as ordinary waste.
- They shall refrain from throwing any bio-medical waste on the streets or open spaces, as well as into the municipal dust bins or the domestic waste collection sites.
- They shall also refrain from throwing any ordinary solid waste on footpaths, streets or open spaces.
- They shall keep colour-coded bins or bags as per the directions and guide lines of the Govt. of India, CPCBs & State PCBs for the storage of biomedical waste, amputated limbs, tissues, soiled bandages, used injections, syringes, etc. Another container with a lid for storage of food waste and other waste fit to be disposed of into the municipal domestic waste stream shall be separately provided.
- The mouth of the polythene bags containing bio-medical waste shall be tied with strong thread and at the end of each day such bags shall be removed from the wards, theatres, dressing room etc. and stored at a safe place in a packed condition for handing over to the municipal authorities for disposal on a daily basis.
- The instructions of the CPCB / State Pollution Control Boards in regard to Colour Code of bags and source segregation of bio-medical waste etc. shall be strictly followed by all concerned.

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SUGGESTIONS AND RECOMMENDATIONS

- Standardization of hospital solid waste management system.
- Collect various types of hospital / clinical waste in four different containers as describe below :
  - **For microbiological, surgical, human anatomical organs, tissues, blood and blood fluid, pathological waste, soiled cotton, dressing, animal waste in yellow container.**
  - **For Disposables, plastic, PVC, polyethylene, sharps (e.g. needles, blades etc), discarded glass in red container.**
  - **For general waste i.e. food waste, kitchen waste, papers, cardboard, in green container.**
  - **For discarded medicine cytotoxic drugs in black container.**
- Recommended colour coding for segregation of bio-medical waste at the point of generation and possible disposal options are given below.

TYPE OF CONTAINERS FOR DISPOSAL OPTIONS OF BIO-MEDICAL WASTE

Colour coding	Type of Container	Waste Category	Treatment options
Yellow	Leak Proof Plastic bag / Disinfected Container	Micro-biological, Surgical, Human Anatomical Organs, Tissues, Blood & Body Fluid, pathological Waste, Solled Cotton, Dressing, Animal Waste	Incineration & MSLF
Red	Punture Resistance, Impermeable, Rigid, Tamper Resistance	Disposables, plastic, PVC Polythelene, Sharps [e.g. Needle, Blades, etc.] Discarded Glass Wares	i. Autoclaving / Micro-Waving, Shredding, Incineration & MSLF ii. Chemical Treatment & MSLF
Green	Leak Proof Plastic Bag	General Waste i.e. Food Waste, kitchen Waste, papers, card Board	Incineration & or Sanitary Land Filling.
Black	Plastic Bag	Discarded Medicines, Cytotoxic Drugs	To be sent to the Manufacturer

- Handle and dispose off bio-medical waste as per the norms, prescribed by the Ministry of Environment and Forests under the Environmental Protection Act, 1986 vide Notification No. S. O. 746 (E) dated 16th Oct., 1997.
- Awareness development among hospital staff, waste handlers, rag pickers and the community as well.
- Introduction of statutory waste auditing system in all hospitals and disposal sites by environmental engineers both at micro level & macro level.

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- Minimization of hospital waste.
- Non-degradable item specially PVC plastic should be used as minimum as possible.
- Location of Treatment & Disposal Site should be as follows.

Sl. No.	Location / Type of Hospital	Site of treatment / Disposal	Authority to whom Responsibility Should be Given for Transportation & Disposal
1.	Very Big Hospitals, where No. of beds >500. Sufficient land is available and is not situated in density populated area.	On-Site	Self (Hospital Authority)
2.	City / Big Urban Area Hospitals (if not as Sl. No. 1)	Off-Site	A consortium of Hospital authorities on commercial basis, Dr. by Municipal Aut.
3.	Urban/Sub-Division Town Hospital	Off-Site	Private Participation under the guidance of Local Municipal Authority
4.	Rural Hospitals	On-Site	Self (Hospital Authority)

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WHAT SHOULD NOT BE DONE

- Throwing of waste on the street
- Open waste storage in road side vats or in other unhygienic street bins
- Allow waste handlers without hand gloves and masks and shoes
- Transport waste into uncovered van
- Allow waste to touch ground in between collection and transportation
- Multiple handling of waste in the matter of collection, transportation and disposal of waste
- Use of unproven technologies
- Mix up construction debris into general waste
- Mix up hospital waste/ clinical waste (bio-medical waste) with general waste

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WHAT SHOULD BE DONE

- Impose fine on throwing waste on the street
- Storage of waste at source
- Door step collection of waste
- Sweeping of streets on all working days of the year
- Impose work norms sweeping of street
- Conservancy workers should be engaged for 8 working hours a day; at least 6 hours a day
- Provide litter bins at public places
- Transportation of waste to synchronize with waste storage facility – dispense with manual loading of waste
- Before dumping the SW in landfill site the bottom of the site should be covered with a thin polythene sheet
- To increase the capacity of dumping the land-fill site may be excavated up to the depth above the permanent ground water table
- Create awareness about the hazards associated with solid waste
- Encourage N.G.O.s to take part in solid waste management system
- Encourage private sector participation in waste management
- Increase public participation in primary collection of waste
- Transport waste on day to day basis in closed body vehicle
- Dispose of waste in an environmentally accepted manner through establishment of sanitary landfill site
- Introduce element of cost recovery
- Creation of public grievances redressal mechanism
- Enforce sanitation laws and rules
- Create heavy a forestation surrounding the landfill site
- Conversion of Organic / Biodegradable Waste into Bio Organic fertilizer (compost)
- Create management information system for solid waste
- Enactment of a public cleansing law and empowering the local bodies for its effective implementation
- Appropriate design for community containers, primary collection and transport vehicles, transfer locations and disposal facilities
- To evaluate better management and optimum utilization of man and materials

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PUBLIC PRIVATE PARTICIPATION {PPP}

Various Forms Of Public Private Participation In Solid Waste Management System

1. Engagement of local BPL persons or NGOs for door to door collection of solid waste.

(Implements for collections may be supplied by the municipalities and the collectors may be allowed to collect Rs.20/- to 30/- per month per APL family and Rs. 10/- to 12/- from BPL families, for house to house collection of waste.)

2. Engagement of private agencies for transportation of solid waste from transfer station to disposal sites.

(The private agency may be made responsible for transportation of total waste of the town to dumping ground on yearly contact basis. The total cost of vehicles and machineries and other necessary arrangement of transportation of waste and O & M cost should be borne by the private agency. It is advisable that the agreement with the private agency may be made for transportation of the total waste generated in the town as lump-sum contact basis irrespective of no. of trips or quantity of waste transported.)

3. Engagement of private agencies for solid waste processing

(The private agency may be made responsible for processing of bio-degradable waste in to manure The private agency would sell the manure produced from the waste and will pay a royalty to the Municipality on yearly contact basis. The total cost of plant machineries and other necessary arrangement of processing unit of the waste and O & M cost should be borne by the private agency. The Municipality will only send the waste to site and provide the land for Biogas plant.)

4. Engagement of private agencies for solid waste processing and disposal.

(The private agency would be responsible for processing of degradable waste in to manure and sanitary disposal of non-degradable waste brought at site. The private agency would sell the manure produced from the waste and will pay a royalty to the Municipality on yearly contact basis. The total cost of plant & machineries and other necessary arrangement of processing unit of the waste and O & M should be borne by the private agency. The Municipality will provide only the land.)

5. Engagement of private agencies for total solid waste management systems i.e collection, transportation, processing and disposal of waste.

(The private agency may be made responsible for the entire process of SWM system i.e. collection–transportation-processing of degradable waste in to manure and sanitary disposal of non-degradable waste of the town. The private agency would sell the manure produced from the waste and will pay a royalty to the Municipality on yearly contact basis. The total cost of plant & machineries and other necessary arrangement of processing unit of the waste and O & M cost should be borne by the private agency. The Municipality will provide only the land.)

Municipal Authority may go for Public Private Participation {PPP} in any or combination of two or more forms of PPP stated above. Detailed terms & conditions of PPP may be worked out on the merit of specific case.

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জেলা – মেদিনীপুর | খতিয়ান নং– ২ | [১০২৪২০০]

মৌজা – হোসেনাবাদ | জে.এল.নং– ২০০ | থানা – মেদিনীপুর

(১) রাজস্ব – ১,১৪৪.৭৩ টাকা

(২) জমির মোট পরিমাণ – ১১.২০ একর (৩) মোট দাগের সংখ্যা – ২৪

(৪) অত্রস্বত্বের দখলকারের বিবরণ	(৫) স্বত্ব	(৬) মন্তব্য
নাম	চেয়ারম্যান মেদিনীপুর মিউনিসিপ্যালিটি	রায়ত
পিতা/স্বামী**		
ঠিকানা	নিজ	অত্র খতিয়ানের স মুদয়জমিবিজ্ঞাপি তসেচএলাকাভুক্ত.

(৭) অত্রস্বত্বের নিজ দখলীয় জমি ঃ

দাগ ন	জমির শ্রেনী	মন্তব্য	দাগের মোট পরিমাণ	দাগের মধ্যে অত্র স্বত্বের	দাগের মধ্যে স্বত্বের জমির পরিমাণ
			একর	অংশ	একর
৩	বালুখাদ		০.৬২	১.০০০০	০.৬২
৮	বালুখাদ		০.৮৩	১.০০০০	০.৮৩
৯	ধানী সোয়েম		০.৪৩	১.০০০০	০.৪৩
১০	বালুখাদ		০.৯৬	১.০০০০	০.৯৬
১১	ধানী সোয়েম		০.৯৭	১.০০০০	০.৯৭
১২	বালুখাদ		১.০৩	১.০০০০	১.০৩
১৪	বালুখাদ		১.৫১	১.০০০০	১.৫১
১৫	বালুখাদ		০.২৬	১.০০০০	০.২৬
১৬	বালুখাদ		০.২৩	১.০০০০	০.২৩
১৭	বালুখাদ		০.৪৮	১.০০০০	০.৪৮
১৮	ধানী সোয়েম		০.১৬	১.০০০০	০.১৬
১৯	ধানী সোয়েম		০.০৯	১.০০০০	০.০৯
২০	ধানী সোয়েম		০.১৪	১.০০০০	০.১৪
৩৩	পুকুর		১.০৫	১.০০০০	১.০৫
৩৪	পুকুরপাড়		১.৪০	১.০০০০	১.৪০
২/৭৫১	ধানী সোয়েম		০.৪৪	১.০০০০	০.৪৪
৮/৭৫৫	বালুখাদ		০.১৮	১.০০০০	০.১৮

দাগের মোট সংখ্যা

Revenue Officer
S.D. & L.R.O. Sadar
Paschim Medinipur

[১০২৪২০০]

জেলা – মেদিনীপুর খতিয়ান নং– ২

মৌজা – হোসনাবাদ জে.এল.নং– ২০০ থানা – মেদিনীপুর

(১) রাজস্ব – ১,১৫৪.০০ টাকা

(২) জমির মোট পরিমাণ – ১১.২০ একর (৩) মোট দাগের সংখ্যা – ২৪

(৪) অত্রস্বত্বের দখলকারের বিবরণ		(৫) স্বত্ব	(৬) মন্তব্য
নাম পিতা/স্বামী*** ঠিকানা	চেয়ারম্যান মেদিনীপুর মিউনিসিপ্যালিটী নিজ	রায়ত	অত্র খতিয়ানের স মুদয়জমিবিজ্ঞাপি তসেচএলাকাভুক্ত.

(৭) অত্রস্বত্বের নিজ দখলীয় জমি ঃ

দাগ নম্বর	জমির শ্রেনী	মন্তব্য	দাগের মোট পরিমাণ	দাগের মধ্যে অত্র স্বত্বের	দাগের মধ্যে স্বত্বের জমির ত পরিমাণ	
			একর	অংশ	একর	
৪/৭৬৫	বালুখাদ		০.০৮	১.০০০০	০.০৮	
৮/৭৬৬	বালুখাদ		০.০৮	১.০০০০	০.০৮	
৯/৭৬৭	বালুখাদ		০.১২	১.০০০০	০.১২	
১৯/৭৬৮	বালুখাদ		০.০৪	১.০০০০	০.০৪	
২০/৭৬৯	বালুখাদ		০.০৬	১.০০০০	০.০৬	
১৯/৭৭৫	ধানী সোয়েম		০.০২	১.০০০০	০.০২	
১৯/৭৭৬	ধানী সোয়েম		০.০২	১.০০০০	০.০২	
		জোর দং (১) শোভা রানী দাস পিতা-গঙ্গা প্রসাদ সাং-নিজ অংশ-১.০০০০ ১৩৫৭ সন হইতে				
			১১.২০			

দাগের মোট সংখ্যা চব্বিশ মাত্র

Appl. Fee: Rs.10, Authentication Fee:2 x Rs.10= Rs.20, Total: Rs.30

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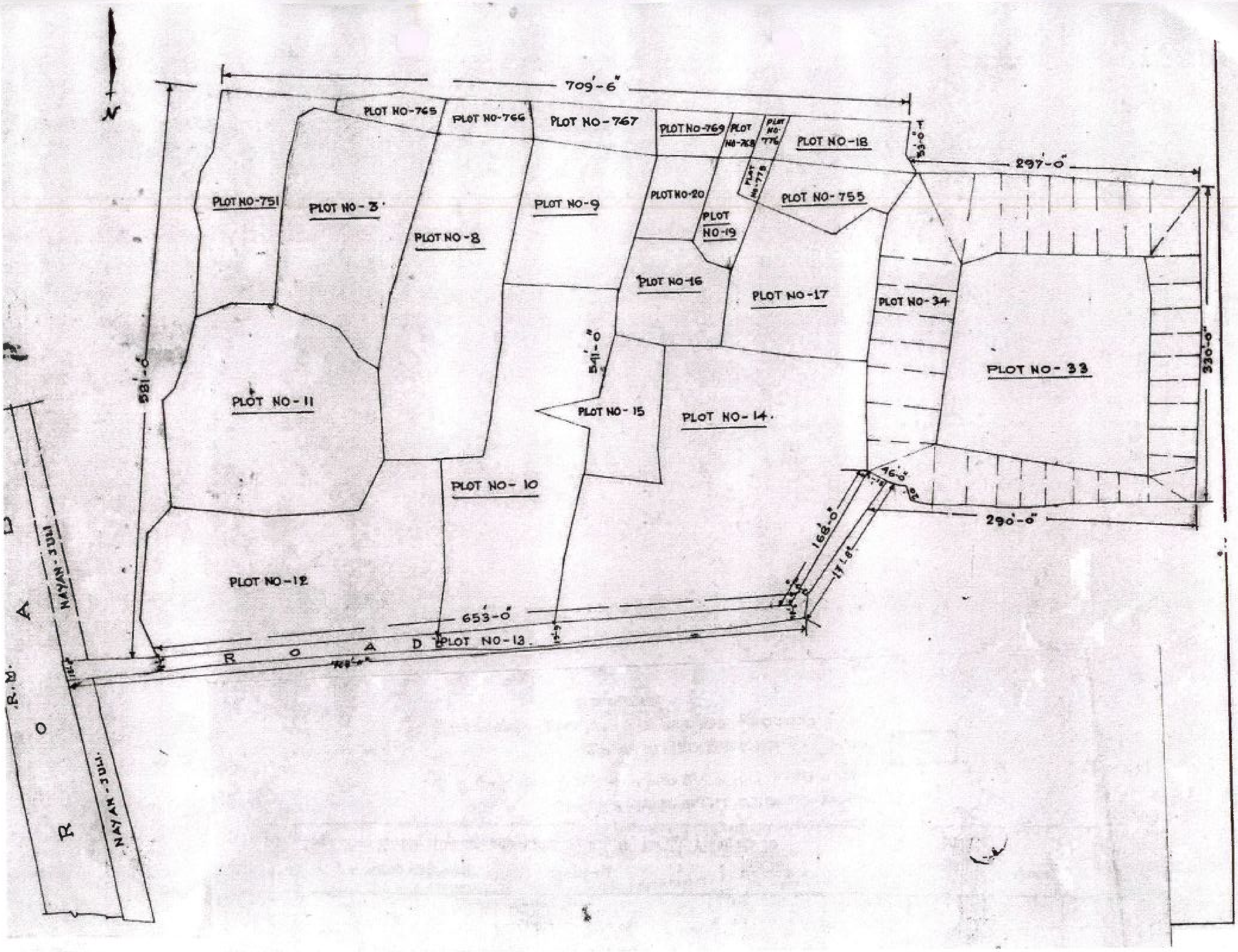
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297'-0"
PLOT NO-751
PLOT NO-3
PLOT NO-8
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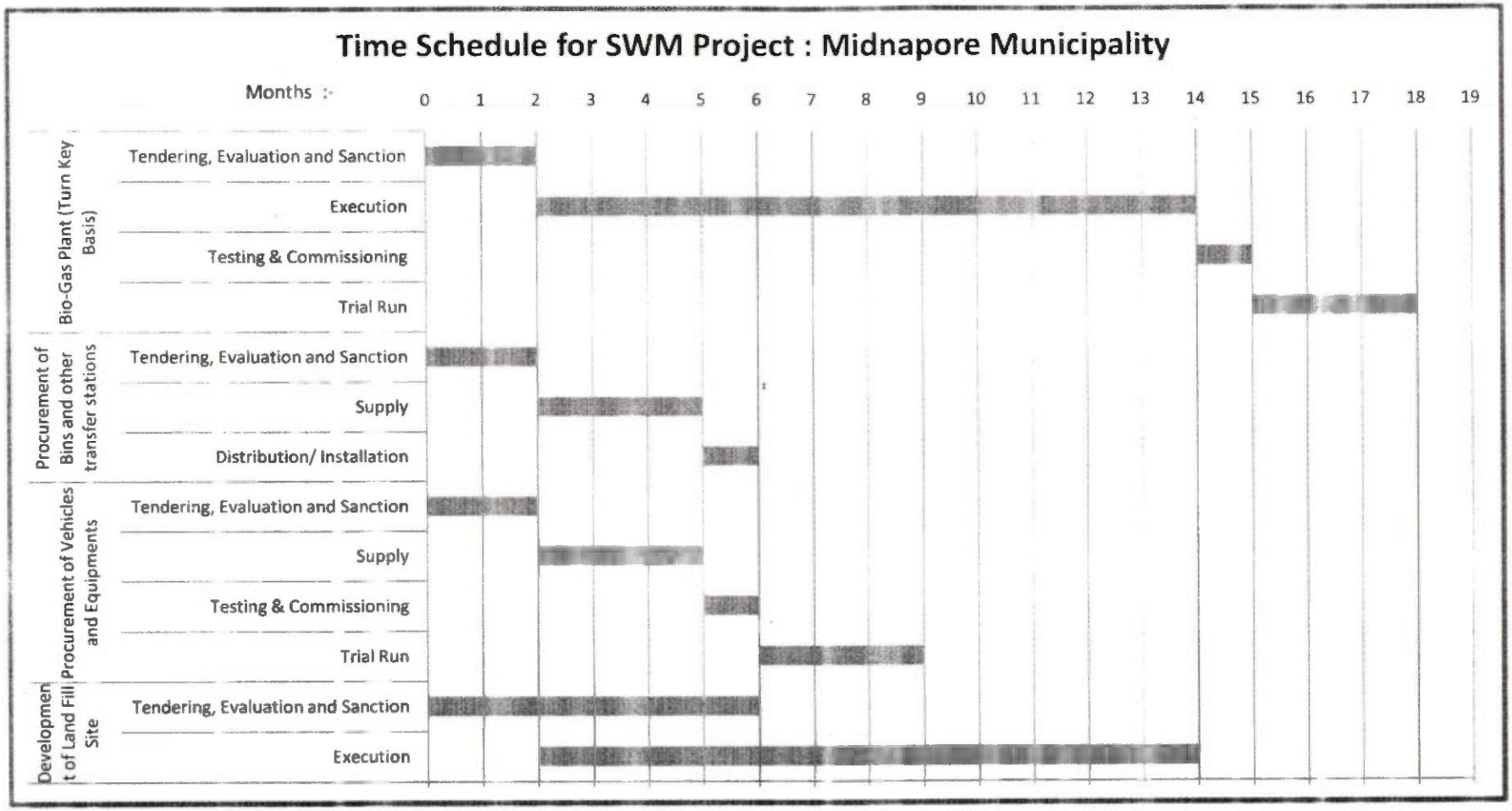
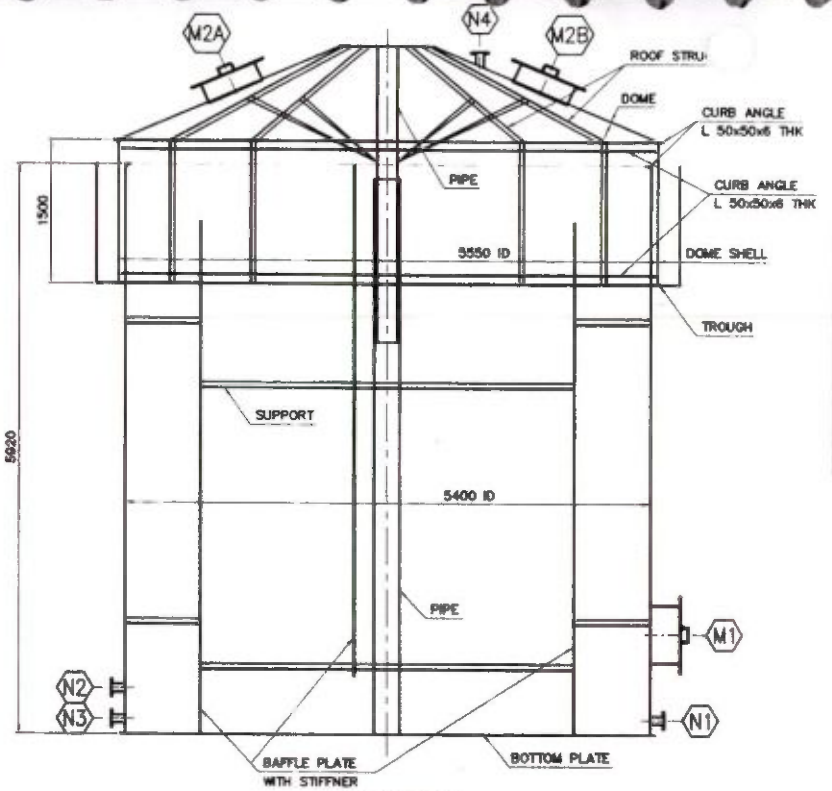
ROAD
PLOT NO-13
NAYAN-JULI
R.M.
ROAD



Sub- Assistant Engineer
MIDNAPORE MUNICIPALITY

Chairman
Midnapore Municipality



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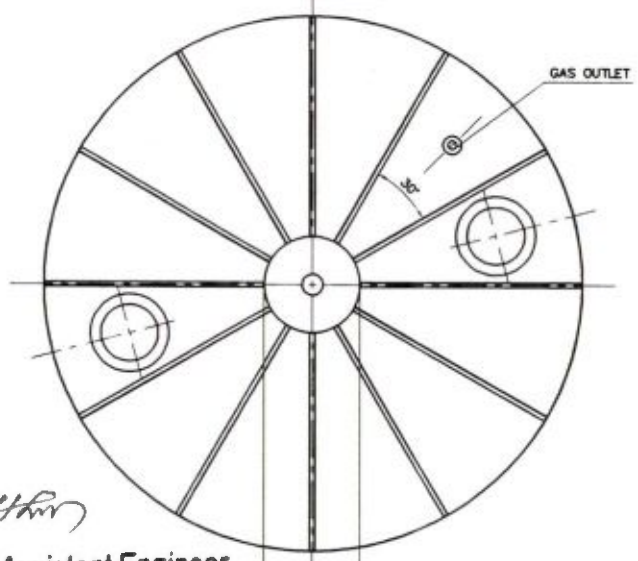


PLAN

Sub- Assistant Engineer
MIDNAPORE MUNICIPALITY

MATERIAL SPECIFICATION

SHELL, BOTTOM, ROOF ETC.	IS : 2062 GR A
STRUCTURAL STEEL	IS : 2062
NOZZLE PIPES	IS : 1239, HVY / IS : 3589
NOZZLE FLANGES	IS : 2062 GR A
GASKETS	CAF
PIPE FITTINGS	A 234 WPB / A 105
BOLTS & NUTS	IS 1367 CL. 4.6/4.0

NOTES:

1) ALL DIMENSIONS ARE IN mm UNLESS OTHERWISE NOTED.
2) ALL NOZZLES BOLT HOLES TO STRADDLE THEIR PRINCIPLE ℄.
3) ALL FILLET WELDS SHALL BE 6mm THK. CONTINUOUS FILLET U.N.O.
4) PROVIDED 6ø TELL TALE HOLE IN ALL REIN PAD PLATES ON HORIZONTAL ℄.
5) CHIP BACK WELD JOINT TO SOUND METAL BEFORE STARTING WELD ON OTHERSIDE.
6) ALL ELEVATION ARE FROM BOTTOM OF BOTTOM PLATE.
7) TANK EXTERNAL SURFACE - SURFACE CLEAN BY MANUAL WIRE BRUSH WITH 1 COAT OF ZINC PHOSPHATE PRIMER (SYNTHETIC BASE) FOLLOWED BY 2 COATS OF SYNTHETIC ENAMEL PAINT.
8) DOME THIKNESS & SUPPORTING STRUCTURE TO BE DETERMINED AS PER DESIGN CALCULATION.
9) SIZE OF TROUGH AS PER DESIGN CALCULATION.

NOZZLE SCHEDULE

DESIGN CODE	IS : 803
DESIGN PRESSURE	ATM
DESIGN TEMP.	AMB
WORKING PRESSURE	ATM
WORKING TEMP.	AMB
HYDROSTATIC TEST PRESSURE	FULL OF WATER
CONTENTS	---
SP. GRAVITY	---
RADIOGRAPHY	NIL
JOINT EFFICIENCY	0.7
CORROSION ALLOWANCE	1.5 (1.0 FOR ROOF)
INSULATION	---
EMPTY WEIGHT	---
WEIGHT (FULL OF WATER)	---
WEIGHT WITH FULL OF PRODUCT	---
CAPACITY	135 M³

NOZZLE SCHEDULE

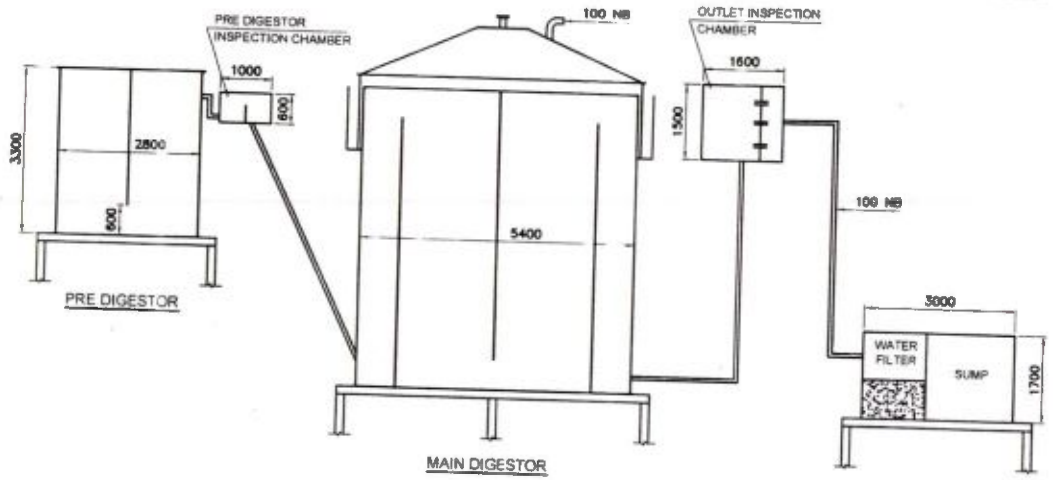
NOZZ.	SERVICE	SIZE NB	SCH.	QTY.	FLANGE STD.	FLANGE TYPE	FLANGE CLASS	PROJ.	REMARK
N1	INLET	80	HVY	01	B16.5	SORF	150#	150	
N2	OUTLET	80	HVY	01	B16.5	SORF	150#	150	
N3	DRAIN	80	HVY	01	B16.5	SORF	150#	150	
N4	GAS OUTLET	50	HVY	01	B16.5	SORF	150#	150	
M1	SHELL MANHOLE	600	5 THK	01	AS PER STD			150	
M2A/B	ROOF MANHOLE	600	5 THK	01	AS PER STD			150	

Chairman
Midnapore Municipality

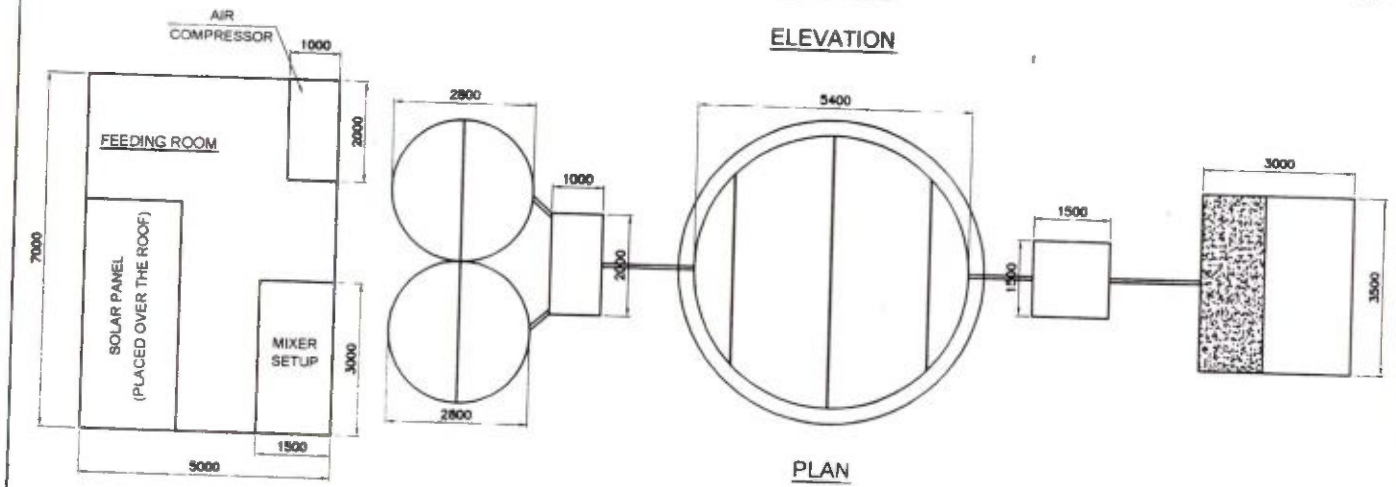
MUNICIPAL ENGINEERING DIRECTORATE

		QTY. 01 NO
PROJECT	MIDNAPORE MUNICIPALITY	
TITLE	GENERAL ARRANGEMENT OF MAIN DIGESTOR	

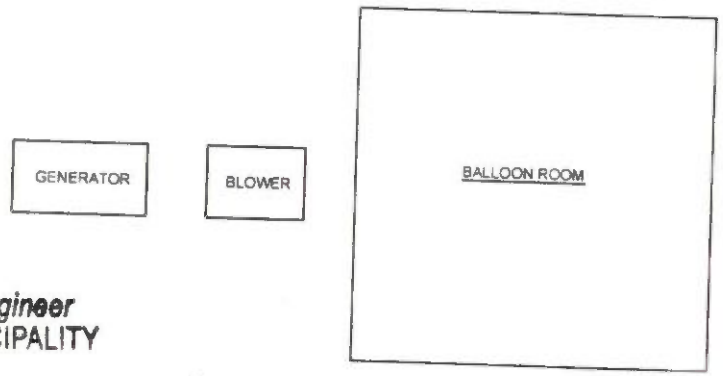
DRN	N.P.H.	DATE	DRG. NO.:-	REV. NO.
CHKD	V.B.T.	09/08/16	MED/MD/01	0
APP	P.N.M.			



ELEVATION



PLAN



Sub- Assistant Engineer
MIDNAPORE MUNICIPALITY

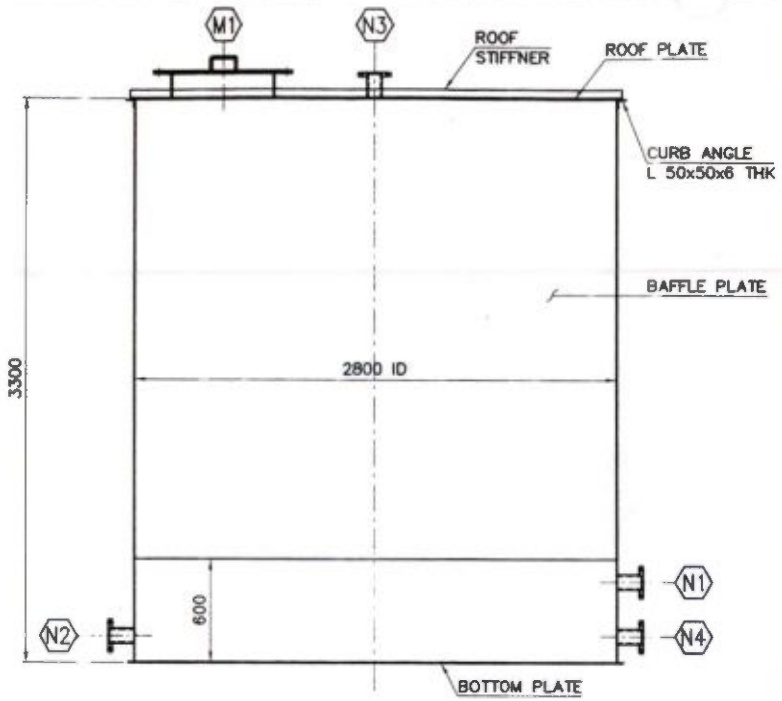
NOTES:

1) ALL DIMENSIONS ARE IN mm UNLESS OTHERWISE NOTED.
2) THE DIMENSION CAN CHANGE BASED ON THE DESIGN CONSIDERATIONS AND SITE CONDITIONS.

Chairman
Midnapore Municipality

MUNICIPAL ENGINEERING DIRECTORATE

PROJECT	MIDNAPORE MUNICIPALITY
TITLE	GENERAL ARRANGEMENT OF BIO GAS PLANT
DRN N.P.H	DATE DPC NO. -



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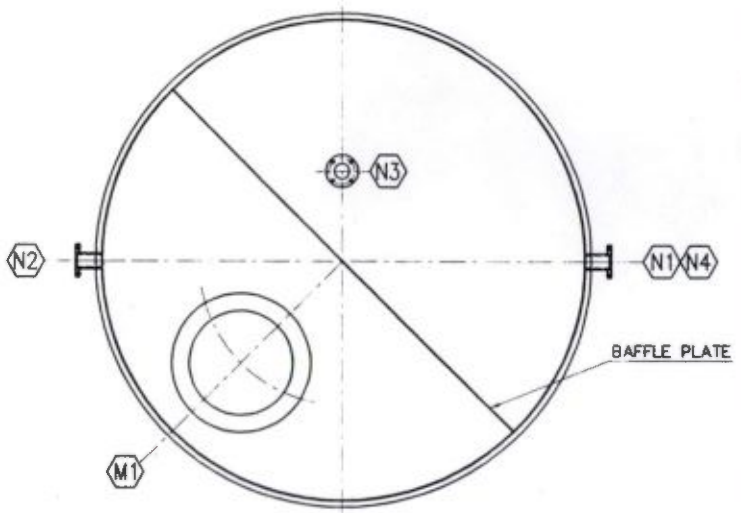

PLAN

MATERIAL SPECIFICATION

SHELL, BOTTOM, ROOF ETC.	IS : 2062 GR A
STRUCTURAL STEEL	IS : 2062
NOZZLE PIPES	IS : 1239, HVY
NOZZLE FLANGES	IS : 2062 GR A
GASKETS	CAF
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NOZZLE SCHEDULE

DESIGN CODE	IS : 803
DESIGN PRESSURE	ATM
DESIGN TEMP.	AMB
WORKING PRESSURE	ATM
WORKING TEMP.	AMB
HYDROSTATIC TEST PRESSURE	FULL OF WATER
CONTENTS	--
SP. GRAVITY	--
RADIOGRAPHY	NIL
JOINT EFFICIENCY	0.7
CORROSION ALLOWANCE	1.5 (1.0 FOR ROOF)
INSULATION	--
EMPTY WEIGHT	--
WEIGHT (FULL OF WATER)	--
WEIGHT WITH FULL OF PRODUCT	--
CAPACITY	20 M^3

NOZZLE SCHEDULE

NOZZ.	SERVICE	SIZE NB	SCH.	QTY.	FLANGE STD.	FLANGE TYPE	FLANGE CLASS	PROJ.	REMARK
N1	INLET	80	HVY	01	B16.5	SORF	150#	150	
N2	OUTLET	80	HVY	01	B16.5	SORF	150#	150	
N3	VENT	80	HVY	01	B16.5	SORF	150#	150	
N4	DRAIN	50	HVY	01	B16.5	SORF	150#	150	
M1	MANHOLE	600	5 THK	01	AS PER STD.			150	

Sub- Assistant Engineer
MIDNAPORE MUNICIPALITY

Chairman
Midnapore Municipality

MUNICIPAL ENGINEERING DIRECTORATE

				QTY.
PROJECT	MIDNAPORE MUNICIPALITY			02 NOS
TITLE	GENERAL ARRANGEMENT OF PRE DIGESTOR			
DRN	N.P.H.	DATE	DRG. NO.:-	REV. NO.
CHKD	V.B.T.	09/08/16	MED/PD/01	0
APP	P.N.M.			

IRG Systems South Asia Pvt. Ltd.
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Siliguri Municipal Corporation
Received
Content Not Verified
Date. 28/11/2016
Head Office

Urban Development Agency
15 FEB 2017

To,
The Commissioner,
Siliguri Municipal Corporation
Bagha Jatin Road,
District:- Darjeeling,
Siliguri - 737001
India

Subject: Submission of Final Report of "Preparation of Detailed Project Report for Solid Waste Management for Selected Cities" - reg.

Dear Sir,

We are submitting the Final Report after incorporating all the comments which was raised by MOUD (Ministry of Urban development) for Siliguri under "Preparation of Detailed Project Report for Solid Waste Management for Selected Cities".

Please issue us final approval letter at the earliest so that we can submit it to Ministry Of Urban Development for their requirement.

Thanking you,

Sincerely,

IRG Systems South Asia Pvt. Ltd. New Delhi

Sanjeev Satyanarayan
General Manager

Compliance Status of the Observations/Comments received from MoUD, CBUD for Draft Report of Siliguri

S. No.	Issue	Observations	Compliance Status	Page/ Para No.
1	Consideration of 30% floating population along with the resident population of the city may be justified. In case of non-availability of backups, the same shall be modified by considering the actual tourists visiting the site which may obtained from the authentic sources like Tourist department of the State.	Data for population projections be justified and validated with other documents like CDP / CSP / projects sanctioned under AMRUT. Data for floating population be validated with other sources like tourist data etc.	Population projection and Floating population has been validated with CDP of Siliguri.	Page No.- 44, Para No.- 5.1
2	Follow Municipal Solid Waste Management Rules (2016) and also aligned with SBM Guidelines	Relined the DPR according to Municipal Solid Waste Management Rules (2016) and also aligned with SBM Guidelines in terms of funding pattern (Central VGF and State Share)	DPR has been prepared aligned with Municipal Solid Waste Management Rules (2016) Provision for funding pattern has been modified as pe SBM guidelines in DPR.	Page No.-139, Para No.- 11.4
3	Check list for submission & scrutiny of DPR (ISWM)	DPR shall be supported with checklist as per contract agreement	DPR has been prepared as per contract agreement.	Attached as Annexure
4	DPR must be reconciled with CDP/Draft CSP/AMRUT and SBM data before finalization of the report.	Data for population projections be justified and validated with other documents like CDP / CSP / projects sanctioned under AMRUT. Data for floating population be validated with other sources like tourist data etc.	DPR has been validated with CDP of Siliguri.	Page No.- 16, Para No.- 2.4
5	Include documents, consultation and photographs	Documents, consultation and photographs shall be make the part of DPR.	As attached with DPR in Annexure of the DPR.	Annexure
6	Impact of SBM Initiative	Impacts of SBM initiative, especially procurement under SBM must be reflect accordingly.	Initiatives taken by ULB have been incorporated in the DPR.	Page No.-135-143
7	Proposed landfill Site only for 5 years	Landfill site may be proposed only for 5 years and modify cost accordingly.	Has been incorporated in DPR	
8	Consideration of SPV	The stand by vehicle shall be worked out by considering the economic conditions of the project area and the availability of the facilities at the site instead of 20%.	Has been Incorporated in DPR	

SILIGURI MUNICIPAL CORPORATION

Preparation of Detailed Project Report for Municipal Solid Waste Management

Final DPR

Nov-2016

IRG Systems South Asia Pvt Ltd

in association with

Feedback Infrastructure Services Pvt Ltd;

Cogent Training Research Consultants Pvt Ltd

Green Origin Ventures Pvt Ltd

Contents

List of Tables

List of Figures

1. INTRODUCTION

1.1 Background

With rapid urbanization, economic development, population growth, changing life styles pattern, waste generation is increasing all across the cities. Improper management of solid waste has become a risk to human health and the environment. Open dumping and improper handling of wastes has led to different type of alarming problems including contamination of water and blockage of drain channels. Poor institutional arrangements, lack of financial resources, inefficient tax collection and non-levy of user charges are the main issues seen in ULBs. Public Private Partnership (PPP) mode of handling solid wastes is still in its stage of infancy. The ULBs with its limited resources particularly in terms of mechanized infrastructure, trained and sufficient man power, scientific waste disposal arrangement etc. are facing difficulty in addressing the sanitation issues in integrated manner. Thus, rises the need of a comprehensive plan and programme through proper capacity building both among the staffs and the local residents regarding waste collection, transportation and safe disposal along with activities to prevent or recycle waste.

In order to give an impetus to reforms under JNNURM, the MoUD and Ministry of Housing and Urban Poverty Alleviation (MoHUPA) had launched a new project called **"Capacity Building of Urban Development" (CBUD).** The project had been launched with support from The World Bank. The broad aim of the project is to address the Major Constraints of urban development and specifically focus on the capacity building requirements for successful urban management and poverty reduction.

The project has following three components:

1. **Capacity Building for Strengthening Urban Management:** This component is aligned with the infrastructure and governance sub-mission of JNNURM and will thus support technical assistance regarding urban management topics.
2. **Capacity Building for Effective Urban Poverty Monitoring and Alleviation:** These capacity building initiatives are aligned with the basic services to the urban poor submission. They reflect the need for building information systems, sharing experiences, and designing strategies on urban poverty alleviation.
3. **Implementation Support:** This component will support a national Project Management Unit (PMU) for providing overall technical and managerial support during the implementation of the Program. The PMU will have a critical role in promoting and supporting the project.

1.2 Purpose of the Task

The Purpose of the Task is "Preparation of Detailed Project Report for Municipal Solid Waste Management of Siliguri City".

Waste management is the "Generation, prevention, characterization, monitoring, treatment, handling, reuse and residual disposition of solid wastes". Municipal Solid Waste (MSW) consists of everyday items such as product packaging, grass clippings, furniture, clothing, bottles, food waste, newspapers, appliances, batteries, construction and demolition materials, and non-hazardous industrial wastes.

There is a wide array of issues relating to waste management and those areas include:
Generation of waste, Waste minimization, Waste removal, Waste transportation, Waste treatment, Recycling and reuse, Storage, collection, transport and transfer, Treatment, Landfill disposal, Environmental considerations, Financial and marketing aspects, Policy and regulations, Education and training, Planning and implementation.

1.3 Objectives of the Assignment

The broad objectives of the Detailed Project Report (DPR) would be to determine a technically and economically viable solid waste management project for a phased implementation to meet the requirements of the year 2044.

Following are the specific objectives:

- To analyze the existing solid waste management system.
- To devise a system of Storage of non - Biodegradable waste as well as recyclable waste separately at the source of generation of waste.
- To devise cost effective systems for Primary Collection of waste from the city in general and from the slums in particular.
- To devise an efficient system of day to day cleaning of streets and public places.
- Devising an efficient system of day to day cleaning of public toilets.
- Devising an efficient system of day to day cleaning of drain silt.
- To devise systems to eliminate the age old practice of throwing garbage on the streets or outside the dustbins causing nuisance to the people and posing a threat to the health of the community at large.
- To improve the system of transportation of waste.
- To promote processing of waste for deriving bioorganic fertilizer, reduce quantity of waste going to landfill site; derive income from the processing of waste.
- To ensure safe disposal of waste.
- Project scheduling & cost estimates.
- Project phasing.
- To prepare action plan.
- Organizational and financial studies.
- To set recommendation with respect to reforms & sustainability.

2. CITY PROFILE

2.1 Project Towns

In order to provide an effective solid waste management system, MoUD is implementing CBUD project in 30 cities clustered in 6 zones. Out of the 30 cities following 8 cities are proposed to be taken up for preparation of Detailed Project Report for Municipal Solid Waste Management with focus on innovative technologies. In this report we are planning for Siliguri which comes into East zone in the state of West Bengal.

Table 1: Project Towns under CBUD Project

S. No.	Zone	State	Cities
1	North Zone	Haryana	Kurukshetra
2	North East Zone	Sikkim	Gangtok
3	South Zone	Andhra Pradesh	Vishakhapatnam
4		Kerala	Kollam
5	East Zone	West Bengal	Siliguri
6	West Zone	Gujarat	Bharuch
7	Central Zone	Madhya Pradesh	Siliguri
8		Maharashtra	Solapur

2.2 Siliguri Profile

Siliguri is the head quarter of the plains Sub Division of Darjeeling District of West Bengal and is situated 392 feet above mean Sea level and in the foot hills of the Himalayas on the bank of the river Mahananda. Around 20.11 Sq. Km of SMC Area falls in the Darjeeling District and the remaining 21.79 Sq.Km of SMC area is in the Jalpaiguri District. A part of the city spreads over neighboring Jalpaiguri district. It is located in the Siliguri Corridor a narrow strip of land linking mainland India to its north-eastern states. Siliguri, situated as it is in the plains at the base of the Himalaya Mountains, connects the hill stations such as Gangtok, Darjeeling, Kalimpong, Kurseong and Mirik and northeast states to the rest of India.

It is the largest city of North Bengal. The city is surrounded by dense forest ranges and is prone to wild animals straying into populated areas. Siliguri is the trade and commerce centre and the gate way to the North East India. Siliguri acts as a transit point for air, rail and road, connecting the neighboring countries like Nepal (lies in the west of the city 10 km from Bagdogra), Bhutan (on the North East about 40 km) and Bangladesh (in the south of Fulbari). The strategic location of the city makes it a base for essential supplies to the above regions. The four 'T's - Tea, Timber, Tourism

and Transport - are the main businesses of Siliguri. It is a principal commercial, tourism, transportation, and educational centre in the northern part of West Bengal.

2.3 History

The antiquity of Siliguri is enclosed in a Mystery. According to Sailen Debnath, Siliguri means a heap of stones or pebbles; and in the nineteenth century often the area was called Sillichaguri. Before the treaty of Sagauli in 1816 between British India and Nepal, Siliguri played a transit point between Nepal and the hilly areas of Darjeeling (Doreje-liang) and 'karseong'. There was a river port just to the south of Siliguri, at Phansideoa having trade relations with Maldah and thereby with other areas of Bihar and Bengal.

The city of Siliguri in its present form started from the bank of Mahananda to Saktigarh, a small village which is now in southern part of the city. When the British East India Company introduced Railway to North East India, it enhanced the importance of the region.

The growth of the town received momentum after the independence of India in 1947. First there were thousands of refugees pouring in from East Pakistan after the country was divided, followed by refugees from Assam in the 1960s who lost their home in anti-Bengali riots there. During this period, there were several wars in which Siliguri was the centre stage. The 1962 war with China, the 1965 war with Pakistan and ultimately the 1971 war with Pakistan and the creation of Bangladesh – each of these events contributed major inflow of refugees to the town.

Siliguri was a tiny village of less than 800 population in 1901 and received its recognition as a municipal town with a population of 32,480 with an area of 15.54 Sq.km in 1951. The population of the town continuously increased leading to its expansion because of the many immigrants from Bangladesh, Nepal, Southern Bhutan and adjacent Indian states came here for the livelihood.

2.3.1 Location and Regional Setting

Siliguri is situated at the latitude of 26'71" and at longitude 88'41". Siliguri is located in the Siliguri Corridor or Chicken's Neck - a very narrow strip of land linking mainland India to its north-eastern states. The Total area of Siliguri city is 42 Sq. Km.; Most of City lies in Darjeeling district, however a part of the city is spread over in neighboring Jalpaiguri district.

Siliguri is located at a distance of 600 km from Kolkata. Siliguri is situated in the plains at the base of the Himalayan Mountains it connects the hill stations such as Gangtok, Darjeeling, Kalimpong, Kurseong and Mirik and North East to the rest of India.

Sliguri is the largest city of North Bengal. It has the unique and unforgettable geographical feature, Nepal lies in the west of the city 10 km from Bagdogra, Bhutan on the North East about 40 km, China on the North about 180 km.

Regional Setting:

- City connects three international borders (Bangladesh, China and Nepal).
- Siliguri became a trade hub for the whole West Bengal due to its location.
- It is a principal commercial, tourism, transportation, and educational center of North Bengal.
- It is connected to Kalimpong and Sikkim by road.
- It is connected by Rail to Darjeeling and Jalpaiguri.
- Siliguri occupies a leading position in all type of business.

2.3.2 Topography

Siliguri is situated in plains at the foothill of Himalayan Mountains. The City slopes from North to South and Southeast direction. The western portion of the City slopes towards Mahanadi River flowing in North to South direction through the project site and Eastern part of the project slopes towards Sahu river flowing in North – South direction along eastern boundary of the City.

The northern part of North Bengal is largely made up of glacial and fluvio-glacial deposits of the Quaternary period, while most of the southern part consists of Pleistocene to recent flood plain deposits.

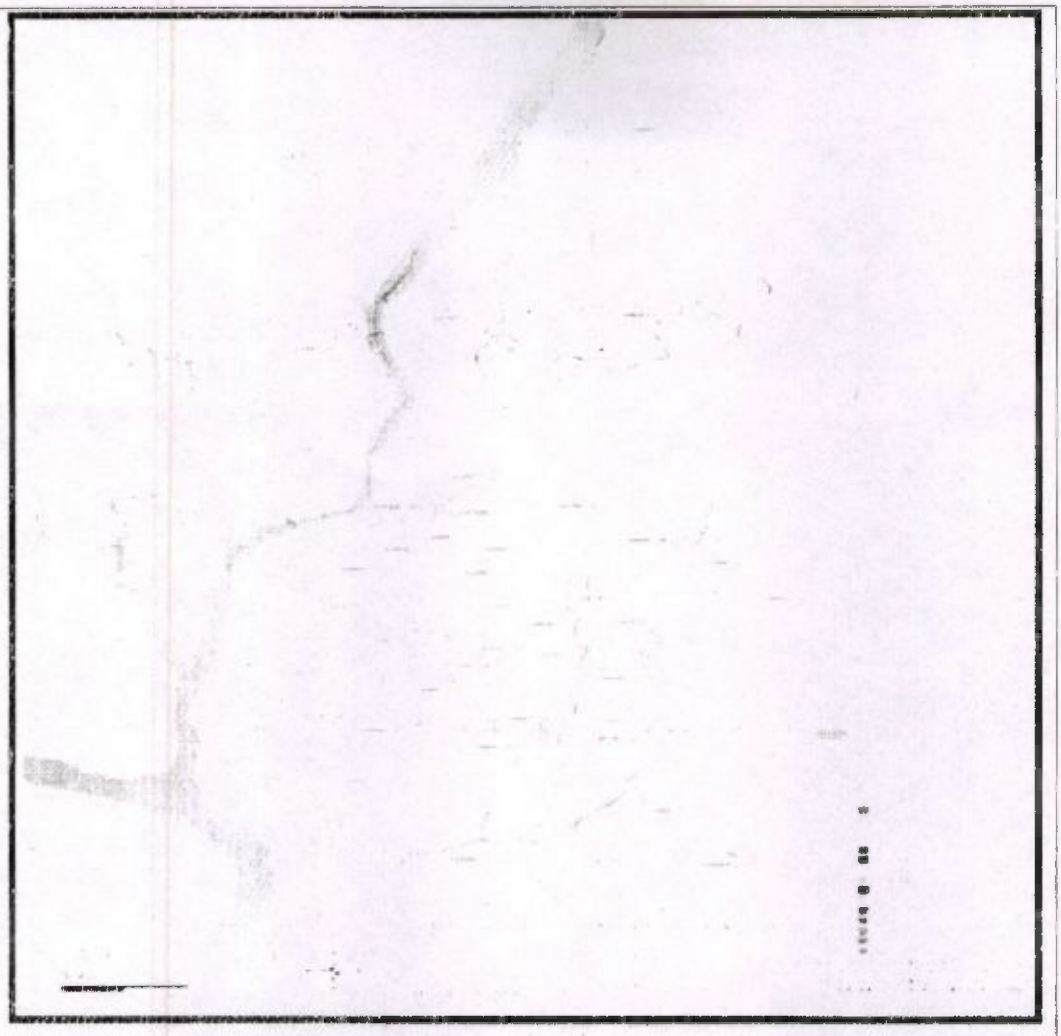


Figure 2: Topographic Map of Siliguri,

2.3.3 Climate

Siliguri has humid subtropical climate. It is in a zone of subtropical climate characterized by hot, humid summers and generally mild winters.

- The average temperature of summer is comparatively low and rarely exceeds 35°C.
- It is hottest in the month of May up to Mid-June with an average Temperature of 28°C.
- Siliguri lies in the shadow of Himalayas; it is comparatively cooler than the central and southern regions of West Bengal.
- The monsoon season in Siliguri starts from Mid-June and lasts up to September.
- A large variation of rainfall can be observed in the climate of Siliguri.
- The winter of Siliguri continues during December to February.

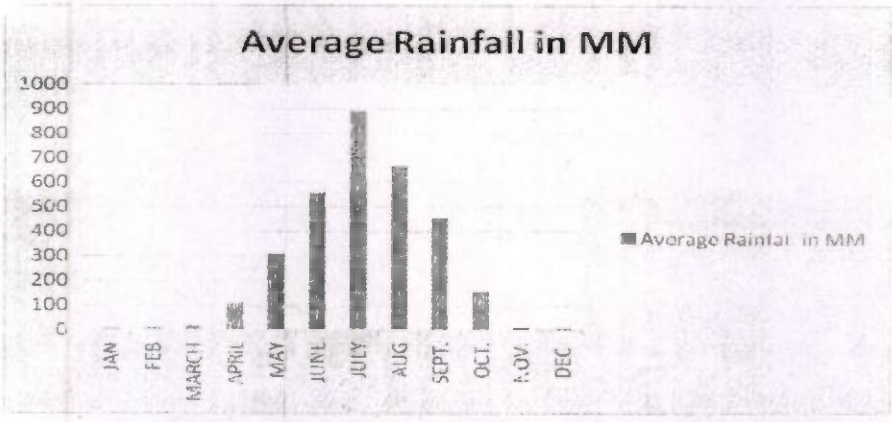
- Winters are relatively cool and temperature ranges from 3°C to 15°C.
- From Mid-December to early January the temperature drops down to 8-10° C.

2.3.4 Rainfall

A large variation of rainfall can be observed in the climate of Siliguri. The annual average rainfall ranges from 3165 mm to 3522 mm as per district level data available from 2009 - 2013. Heavy rainfall occurs in the month of July and August; intense rainfall up to 200 mm per day has been recorded in these periods in the past. The difference in precipitation between the driest month and the wettest month is 902 mm. The average temperatures vary during the year by 11.4 °C.

Table 2: Rainfall in Darjeeling District as per IMD during 2009-2013

Rainfall in Darjeeling District as per IMD During 2009-2013													
Year	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	Total
2009	0	0	12.9	147	398.4	350.4	765.2	759.8	265.8	307.3	0.5	1.8	3009.1
2010	0	3.4	6.8	73.3	304.3	635.5	981.4	913.7	468.7	136.3	15.2	0	3538.6
2011	3.7	8.2	20.2	98.7	233	620.2	1070.3	644.6	589	30	16.4	4.2	3338.5
2012	7.2	2.8	2.2	141.7	152.4	627.5	902.1	478.8	587.8	67	0	0	2969.5
2013	7.3	24.5	28.5	83.6	441.6	540.7	727.1	537	348.2	224.6	6	1.4	2970.5
Ave.	3.6	7.8	14.1	108.9	305.9	554.9	889.2	666.8	451.9	153	7.62	1.5	3165.2

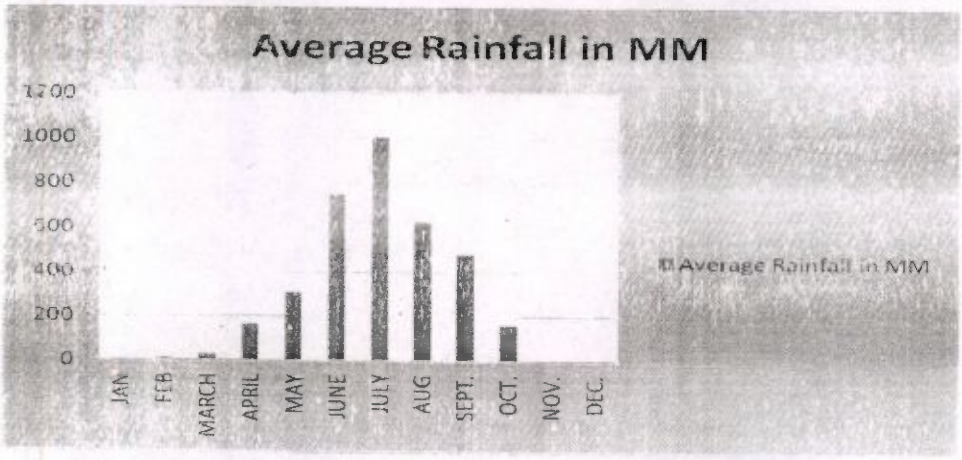


Source IMD: Average Rainfall of District Darjeeling during 2009-2013

Table 3: Rainfall in Jalpaiguri District as per IMD during 2009-2013

Rainfall in Jalpaiguri District as per IMD During 2009-2013													
Year	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Total
2009	0	0	33.5	153.9	258.2	656.2	698.5	746.3	263.8	322.5	2.5	2.4	**3137.8**
2010	0	3.1	43	225.8	420.8	873.1	1164.7	783.7	552.7	73.7	5.6	0	**4146.2**
2011	2.3	8.2	44.4	161.7	276.6	530.9	924.7	543.5	490.6	39.9	9.5	2.8	**3035.1**
2012	5.4	3.8	5.8	164.4	264	1057.3	1110.9	455.8	598	155.3	0	0.1	**3820.8**

Rainfall in Jalpaiguri District as per IMD During 2009-2013													
Year	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Total
2013	1.3	13.8	8 8	120.3	316.2	634.1	1091.1	594.4	485	202	5.6	0.1	3472.7
Ave.	1.8	5.8	27.1	165.2	307.2	750.3	998	624.7	478.	158.7	4.6	1.1	3522.5



Source IMD: Average Rainfall of District Jalpaiguri during 2009-2013

2.3.5 Transport

Siliguri is well connected to the other parts of India by Air, Rail and Road. A brief description of the transport network in Siliguri is provided below:

Air:

Siliguri has its own domestic airport which is located in Bagdogra at a distance of 12 Kms from city center. The airport is connected to Bengaluru, Chandigarh, New Delhi, Kolkata, Guwahati, Mumbai, Chennai, Bangkok, and Paro (Bhutan).

There is also a regular helicopter to Gangtok.

Rail:

New Jalpaiguri station is the nearest railway head to Siliguri which is located just 16 Km south of Siliguri. Jalpaiguri Station is linked to all major stations in the country like Delhi, Mumbai, and Bangalore with regular train service.

Road:

Siliguri is about 600 Km away from Kolkata. There is regular bus service to Kolkata and other important places in West Bengal like New Jalpaiguri and Kharagpur. Private buses are also operational between the cities.

2.3.6 Administrative Set-up

In 1907 the town became a subdivision. The Siliguri municipality was established in 1949. Siliguri Municipal Corporation was established in the year 1994. General information about the municipal corporation is provided below:

Table 4: General Information about SMC

Particular	Details
Name of the City	Siliguri
Year of Establishment of Municipal Corporation	1994
Area under Municipal Corporation	41.9 sq. km
District	Darjeeling and Jalpaiguri
Number of Wards	47
Number of Wards in Darjeeling	33 (Ward No. 1 to 30 & 45,46,47)
Number of Wards in Jalpaiguri	14 (Ward No. 31 to 44)

Source: SMC

It is to be noted that the Municipal area in 1994 was 26.37 Sq. Kms, in 1994 it was increased to 41.9 Sq. Km.

As per the West Bengal Municipal Corporation (Amendment) Act 2009, a group of wards are administered by the Borough Committee. Each borough consists of minimum 6 contiguous wards. The chairman of the borough is elected by the ward councilors, of the wards under that borough. The borough governs the civic services to their respective wards.

In Siliguri Municipal Corporation, 47 wards are divided in to 5 Borough as follows:

Table 5: Number of Wards in Borough

Borough	Wards	Total No. of Wards
No. I	1, 2, 3 ,4, 5, 45, 46, 47	8
No. II	6, 7, 8, 9, 10, 11, 12, 13, 14, 15	10
No. III	16, 17, 18, 19, 20, 21, 22, 23, 24, 28	10
No. IV	25, 26, 27, 29, 30, 31, 32, 33, 34 ,35	10
No. V	36, 37, 38, 39, 40, 41, 42, 43, 44	9

Source: Rapid Baseline Assessment – Siliguri Draft Report (MOUD)

2.4 Population

As per 2011 India census, the total population of Siliguri is more than 5 lakhs in an area of 41.9 sq. kms. The population of the town has continuously increased leading to its expansion because of the huge immigrants from Nepal, Southern Bhutan and adjacent Indian states apart from eastern Bengal. The sudden increase in population in 2001 can be due to the formation of Siliguri Municipal Corporation in 1994 and addition of 17 wards within the corporation limits.

Table 6: Siliguri Population as per Census of India

Year	Population
1981	153825
1991	216950
2001	470275
2011	513264

Figure 3: Ward Map of Siliguri

Table 7: Ward Wise Population and density of population

Ward No.	Population	No. of Families	Area (Hectares)	Population Density (PPH)
1	18928	3958	230	82.30
2	14327	3418	150	95.51
3	10993	2241	102	107.77
4	20745	4394	113	183.58
5	16369	3018	122	134.17
6	6484	1147	20	324.20
7	7954	1603	32	248.56
8	5097	897	20	254.85
9	6481	1113	28	231.46
10	4019	851	77	52.19
11	1912	398	16	119.50
12	2832	683	24	118.00
13	4886	986	28	174.50
14	6566	1598	32	205.19
15	8002	2071	34	235.35
16	4922	1287	24	205.08
17	5029	1366	20	251.45
18	7774	1693	16	485.88
19	3286	927	20	164.30
20	9003	2181	24	375.38
21	5624	1407	32	175.75
22	10182	2589	48	212.13
23	6340	1550	28	226.43
24	11045	2715	48	230.10
25	9459	2135	25	378.36
26	5038	1161	24	209.92
27	6892	1740	36	191.44
28	8836	2031	69	128.06
29	10703	2506	69	155.12
30	7819	2081	43	181.84
31	14424	3491	80	180.30
32	11334	2704	129	87.86
33	14518	3384	113	128.48
34	16999	3912	128	132.80
35	15820	3497	194	81.55

Ward No.	Population	No. of Families	Area (Hectares)	Population Density (PPH)
36	14734	3441	96	153.48
37	15690	3729	64	245.16
38	13022	3325	65	200.34
39	12353	3029	78	158.37
40	25152	5363	243	103.51
41	17351	3839	324	53.55
42	19139	4134	415	46.12
43	16339	3325	177	92.31
44	11843	2722	73	162.23
45	7001	1562	26	269.27
46	30665	6545	363	84.48
47	9327	2210	68	137.16
Total	**513264**	**115957**	**4190**	

Source: SMC

It is clear from above table that the maximum density of population is in ward number 18 and minimum density is in ward number 42.

Males constitute 51% of the population and females 49%. Siliguri has an average literacy rate of 77%, higher than the national average of 74.04%; Male literacy rate is 80% lower than national average of 82.14%, and female literacy rate of Siliguri is 74% higher than national average of 65.46%.

As per census data 2011, the total slum population constitutes 32% of the total urban population in Siliguri as per data provided by SMC.

Table 8: Information about the population in the Municipal area

Particular	Details
Total Population (2011)	5,13,264 (Males - 263,702, Females - 249,562)
Total Slum Population	154 slum pockets; population 1.62 lac (32% of total population)
No. of Household	115957
Decadal Growth Rate (2001-11)	9%
Density	12250 persons per sq. km
Literacy Rate	77%

Source: SMC

Slum Profile

Slums are located along River Mahananda, Fuleshwari and Jorapani, on the railway lands and in the heart of the city near railway town station. Due to ineffective development control

regulations slums have developed on the river beds and on the railway lands resulting into degrading urban environment and unhealthy living conditions.

80% of the slum dwellers are migrants from Bihar, Assam, West Bengal, Bangladesh and Nepal and 69% of them are staying for more than 10 years in the city. Except for some slums on railway land all other slums are notified slums. 76% of the households are living in Kutcha houses and 18.3% of the households live in semi pucca houses.

Slum dwellers are mainly non- agricultural labourer, auto rickshaw drivers, rickshaw and van pullers, vendors and other informal sector workers. They give important contribution to informal economy and making city competitive in the labour market. Generally, more than one person in the family works in the households living in slums to meet daily requirements.

In Siliguri, average earning person per household is 1.3 and 10% of the households have women as only earning member in the family. In spite of employment generation programmes, 20% of the population is unemployed and 34% of the population is underemployed in slums. The slum details are in Table 85 in the Annexure.

Table 9: Slum Details in SMC

Sr. No.	Slum Details	Total	Notified	Non-notified	Unit	As on	Remarks
1.	Slum number	185	154	31	No.	2013	31 new slums were identified
2.	Area	16.19	13.81	2.39	Sq. km	2013	
3.	Population		1,61,376		No.	2001	31.72% of total SMC Population of 5,09,709
4.	Density of Population		11,724		Person/Sq. Km	2001	Density of SMC 5.13 lac/41.9 sq km = 12,148 person/Sq. km
5	Household No.	40,134	35,134	5000	No	2013	Household size 3 in notified slums

2.5 Sex Ratio

The sex ratio of Siliguri city is 946 per 1000 males. Child sex ratio of girls is 931 per 1000 boys.

2.6 Land Use

Land is a vital resource and the most important natural resource in the Municipal Area. Due to increasing urban population pressure the urban local bodies are facing threat of overuse land and abuse of the land resource.

Around 20.11 Sq. Km of SMC Area falls in the Darjeeling district and the remaining 21.79 Sq. Km of SMC area is in the Jalpaiguri district.

As per the Land use Distribution in the SMC 49% of the total SMC area is Residential Land use. 7% of the total Land in the SMC region is of Commercial Use while Industrial Use is just 1%. Public & Semi Public as well as Recreational Land use is 4% each. Transport and Open Land use including unused land are 13% each. Land in Agriculture & Water Bodies has a share of 9% in the total Land use of the SMC.

Table 10 : Land Use Area and Percent wise in Siliguri

Sr. No.	Land use Category	SMC Land use (Sq. Km.)	Land Use (%)
1	Residential	20.66	49
2	Commercial	2.93	7
3	Industrial	0.42	1
4	Public and Semi Public	1.68	4
5	Recreational	1 68	4
6	Transport and Communication	5.45	13
7	Open and Unused Land	5.45	13
8	Land in Agriculture and Water Bodies	3.63	9
		41.9	**100**

2.7 Culture

Major festivals observed at Siliguri are Durga Puja, Chhath Puja, Ganesh Puja, Laxmi Puja, Saraswati Puja, and Dipawali. Baishaki Mela is one of the oldest Mela in Siliguri. The fashion week during winters are celebrated for entertainment. Various concerts are organized by local clubs, which continues from mid of October to Mid of December.

City has lot of group theatres; it hosts many music schools, clubs. In special interest section, there are Automobile club, Laughing club or Cine Club. The city hosts an active and well equipped astronomy club too, Sky Watchers Association of North Bengal.

3. ASSESSMENT OF EXISTING SITUATION

3.1 MSW Generation

The Main Solid waste generation sources are Residential houses, Commercial Markets, Slums, Institutional organizations like Hospitals, Hotels, Restaurants, Construction & Demolition waste (debris), Marriage Halls (Bhawans), Parks/gardens etc. This waste is managed by Municipal Corporation staff engaged in Primary collection, secondary collection, transportation and disposal at landfill site.

3.2 Primary Collection of Waste

3.2.1 From Households

For Primary collection of Household waste every ward has been divided into blocks and each block has 300 to 350 households. Each block has one Primary collector with one tricycle Containing 6 Buckets each having capacity of 40 Kg therefore total loading capacity of Vehicle is 240 Kg. One collector per block makes round during primary collection, He whistles near door of houses and people come to dispose off their Solid waste. Waste collected from house-holds is dumped into secondary waste collection bins placed at specific location in each ward. The collector works usually from 8:00 AM to 12:00 PM.

Figure 4– Covered Van for Solid Waste Collection, User Fee Charge Slip of SMC & Tricycle for Primary Collection

3.2.2 From Hotel and Dhabas

In Siliguri city there are about 200 Hotels at present, they have their own container for waste collection. Every day the waste from the bins is collected by Secondary Collection vehicles.

3.2.3 From Various Markets

Siliguri has 21 Daily Markets, 13 Food & Vegetable Markets, 3 Wholesale commodity markets, 15 Commercial Complex and 8 other types of Markets which generate 12 MT, 6 MT, 25 MT, 4 MT and 2 MT respectively. The management of solid waste is under the municipal corporation

for such areas, secondary collection bins are placed in and around the vegetable market area for vendors and shopkeepers.

3.2.4 From Bhawans/Marriage Halls

In Siliguri there are about 65 Bhawans. In Wedding season mainly from November to February and from May to July, waste is generated from Marriage halls/gardens which are openly dumped at roadside and vacant plots. Waste generated from gardens is generally organic wastes (leaves, paper and grass etc.). This is managed by Municipal Corporation. Municipal workers collect wastes and dump them in secondary collection bins.

Figure 5– Primary Collection from other sources.

3.3 Primary Collection System

The exact number of houses presently served with door-to-door collection is unavailable with the corporation. At present the role of SMC staffs are restricted only to sanitary land-filling. Despite availability of waste bins at strategic locations in the SMC area solid waste is thrown on the streets and in the drains, chocking the drainage system resulting water logging problem especially in the monsoon season. Even though door to door primary collection system is being used, there are certain grey areas in the system.

Table 11: Status of Primary Collection of waste in Siliguri

Sr. No!	Particulars	Existing Status	Remarks
1	Door to Door Collection (DTDC)	Every ward has been divided into blocks of 300 to 350 houses. Waste is being collected in Man Pulled Tri-cycle (Rickshaw). Ward Committee collects a user fee at a flat rate of Rs. 10 per household.	SMC has provided Green and black bins at nominal fees of Rs. 25 per Pair to households through the ward committee for segregation of Biodegradable and Non-Biodegradable Waste. Motivation and awareness of households to segregate waste needs to be increased. Incentives and recognitions can be introduced.
2	Role of engaged staff	From every block one Primary collector collects the waste. He dumps it into Covered Vans/ Secondary Collection bins.	Very Few Households segregate their waste. Waste collected at house hold level is not segregated and is dumped in the bins placed in the try cycle.
3	Staff Knowledge and Attire	Existing staff lacks proper training and knowledge of latest technologies used for SWM. SMC staff while collecting the waste doesn't wear safety masks, gloves and Helmets.	SMC Staff needs training to encourage Households for segregation of their wastes, Not to throw waste in Drains. Also SMC Staff requires Uniform, Gloves, Masks, Shoes etc.
4	Monitoring	Borough level Sanitary inspectors and ward level Sanitary Supervisors are responsible for monitoring and reporting to Chief Sanitary Inspector of SMC.	Solid Waste collection system is under Borough/ward level control making it very difficult for SMC to interfere in wards which are not performing well. The ward level performance needs to be improved. It has been declining in the last few years.

3.4 Secondary Collection of Waste

For Secondary waste collection Municipal Corporation is using Compactors, Dumper Placers, small pickup vans like Tata Xenon and Tata Di. Municipal Solid Waste from secondary collection bins from different locations is carried by these vehicles.

Earlier majority of Solid waste was dumped to Covered Vans (used as secondary collection bins) and was transported to Landfill site using tractors. However, the practice has now been changed as SMC has recently procured new MS bins of capacity 1.1 CUM, 2.5 Cum, 4.5 Cum, dumper placers of capacity 4.5 CUM, Compactors of 7 CUM and 14 CUM for collection and transportation of Solid waste.

Besides Compactor and dumper placer, the secondary collection of waste is done through tractor trolley and trucks from open dumping points. Open dumping points are designated by Municipal Corporation.

There are fifteen dumper placers with SMC. Every day the dumper placers make 2- 3 trips each. They lift the secondary bin and unload it at the same location.

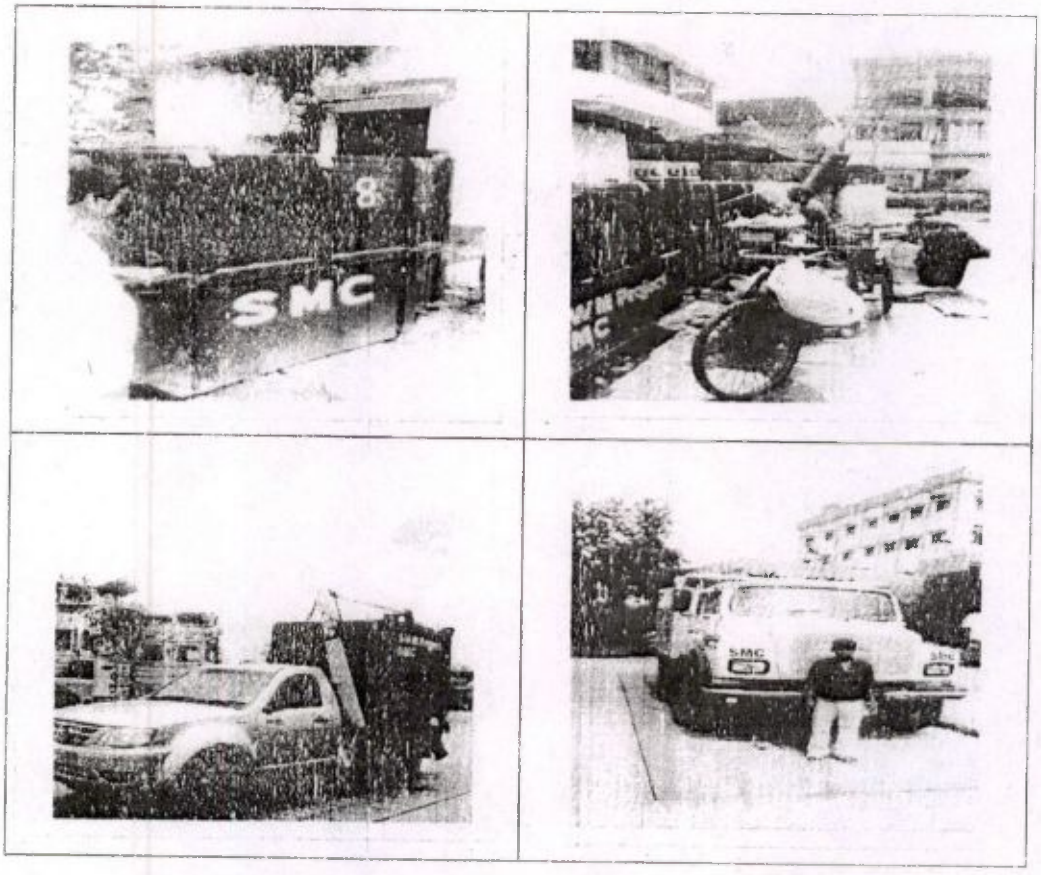


Figure 6– Vehicles used by SMC for Secondary Collection and Solid Waste Dumping ground

Secondary waste is collected in Trucks, Dumper Placers, and Tractors. A total of approximate 100 workers are engaged in secondary collection system which includes both drivers and helpers.

SMC collects municipal waste from secondary collection points and transport it to designated landfill site without any treatment. At source segregation of waste is practiced in few areas of the corporation area. Hence, there is least segregation at secondary collection stage.

3.5 Street Sweeping

Siliguri Municipal Corporation (SMC) carries out street sweeping in all 47 Wards. Street sweeping are manually done with frequency varying from daily to weekly/fortnightly. Hot spots like bus stand, commercial places, and institutional areas are being swept daily and outer areas are swept weekly and fortnightly. Staffs engaged in street sweeping are both male and female, while male staffs are engaged in drain cleaning.

Sweepers use brooms to sweep the streets and collect waste in handcarts. Waste collected is dumped in the nearest bins or open collection points for further transportation. Beat length allotted to each sweeper varies from 400 m to 600 m depending on the population density and width of roads. The total length of road network in the city is approx. 977 km. Street sweepers are not equipped with any personal safety equipments (Mask, Gloves etc.) presently.

Though local vendors and tea stalls have their dustbin/container for solid waste disposal but there are many kiosks that don't have any dustbin/container for waste disposal. As a result, the consumers throw wrappers, polythene etc. openly at the road sides. Open burning has been observed during survey to different parts of the City.

During survey our team observed that Street Sweeping staffs are comfortable with long handled brooms for sweeping. They make heaps of waste at short distances at roadside. They use temporary dustpans (thin sheet of cardboard) for waste collection.

Waste is collected in handcarts and transferred into secondary collection bins. The sweepers have to travel an approximate distance of 300-500 meters for dumping of waste in secondary collection bins.

3.6 Drain Silt Cleaning

The Total road length of Siliguri Municipal Corporation is 976.64 Km. The total lengths of drains are 881.61 Km (SMC). The length of covered drains is 674.74 kilometer while uncovered drain is 206.87 km. Male staffs have been engaged in drain cleaning. They clean minor drains regularly twice in a week but major drains are not cleaned regularly. This has led to deposition of silt. People throw their waste in Major/Minor drains which creates blockage of drains, thus leading to breeding of mosquitoes, flies and odour problem. In every ward Separate Drain cleaning and silt Collection staff has been provided. T sweeping arrangement in Siliguri

Figure 7–Manual handcart carrying Drain Silt

Table 12: Existing Situation of Drain Cleaning

Sr. No.	Particulars	Existing Status	Frequency	Remarks
1	Manually	SMC Drain cleaning staff cleans the drains and leaves the residue on drain side. Drain silt collectors collect the silt in Manual Handcarts/ Tipper Trucks, Trolleys and transport it to landfill site.	Daily	Workers are not provided with any sort of PPE equipments (Boots, Masks, Gloves and Uniform). They work in unhygienic conditions.
2	Mechanized	Front end loader with backhoe is used for cleaning of major drains.	Daily	

Sr. No.	Particulars	Existing Status	Frequency	Remarks
		Major Drains are generally cleaned before Monsoon.		

3.7 Construction and Demolition Waste

Construction and Demolition waste is collected by PWD. It has been observed in some parts of the City that C & D waste is thrown in low lying areas of the town. As PWD is having limited quantity of C&D collection vehicles sometimes SMC vehicles are also used to collect C & D waste. Construction and Demolition waste collected from the City is also dumped at the Landfill Site as there is no separate place for dumping the C & D waste.

C & D waste varies from time to time depending on the construction or demolition activities. A major portion of this waste is generally used in reconstruction activities or for filling up of the low lying areas. At present there are no standard practices for disposal of construction waste in Siliguri town.

3.8 Bio-medical waste

Since 2008 SMC doesn't handle the bio medical waste and the entire operation from primary collection to treatment and disposal is given to Greenzen Bio Pvt. Ltd. The Common Bio-medical Waste Treatment Facility is located at **Mouza Binnaguri**, the same Mouza where the new/proposed dumping ground of SMC is located. However, following non-compliance of environmental regulations, WBPCB had imposed fine on the operator in September-2009 and then after payment of penalty fees and commitment of compliance by the operator the License was renewed. Assistant Environmental Engineer (In charge of the Siliguri Regional Office of PCB) monitor's the operation.

Table 13: Infrastructure for transportation of Solid waste

Sr. No.	Particulars	Capacity	Numbers
1	Hydraulic Dumper/Tipper	16T, 9T, 7T	17
2	Hydraulic Dumper Placer – Tata Xenon/DI - LCV		14
3	Dumper Truck		-
4	Covered Truck		-
5	Ordinary Truck	2 MT	4
6	Tractor	2 MT	23
7	Refuse Trailer (Covered)	2 T	225
8	Refuse Trailer (Uncovered)	-	-
9	Tri-cycle Van	0.5 MT	280
10	Wheel Barrows	50 KG	235
11	Community Bins (Roadside)	1.1,3.5,4.5 CUM	120
12	Bulldozer / Pay-loader		08

Sr. No.	Particulars	Capacity	Numbers
13	Hydraulic Dumper Container	2 MT	150
14	Waste Compactor	7 , 14 CUM	03
15	Cesspool Emptier	3000, 6000 Liter.	07
16	Mechanical Road sweeping Machine		01
17	Sewage Sucker	8000 Liter.	01
18	Any other (Please Specify)	W.C.V.- 3, Desilting M/C-1	04

Source: SMC Conservancy Department

3.9 Processing and Disposal of Solid Waste

After collection and transportation, waste is being openly dumped at landfill site. No further treatment has been taken place for processing of waste. The existing landfill is located in the Northeastern corner of the City near Don Bosco School and Saleshian College. Figure no 7 shows location of existing landfill site whereas Figure 8 shows existing pitches of the site.

Figure 8– Google imagery showing the existing dumping ground near Don Bosco School

Figure 9– Existing Situation of Landfill Site at Siliguri

3.10 Service Level Benchmarks

Service Level benchmarks of the existing Solid Waste Management in the Siliguri City are given in the table below:

Table 14: Service Level Bench Marks (SLB)

S.I No.	Indicators	Existing Situation	Standards according to SWM Rules, 2000, CPHEEO Manual and Service Level Benchmarks	Observations from Consultant's Team
1	Municipal Solid waste collection efficiency (Waste collected – 250 TPD; Generated – 300 TPD)	80 %	According to service level benchmarks, it should be 100%	Unavailability of secondary dustbins at appropriate locations. Awareness among citizens for throwing waste in Proper place is required. Quantification of Solid waste in absence of weigh bridge is not possible.
2	Door to door waste collection	88%	According to service level benchmarks, it should be 100%	MSW is not collected from Ward Nos. 1; 28; 40