Draft Initial Environmental Examination

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India: North-Eastern Region Capital Cities Development Investment Program (Tranche 3) — Aizawl Solid Waste Resource Management Subproject

Prepared by State Investment Program Management and Implementation Unit (SIPMIU), Urban Development Department

For the Government of Mizoram
North-eastern Region Capital Cities Development Investment Program (NERCCDIP)

Asian Development Bank

ABBREVIATIONS

ADB	—	Asian Development Bank
AMC	—	Aizawl Municipal Council
CBO	—	community building organization
CLC	—	City Level Committees
CPHEEO	—	Central Public Health and Environmental Engineering Organization
CTE	—	Consent to Establish
CTO	—	Consent to Operate
DSMC	—	Design Supervision Management Consultant
EAC	—	Expert Appraisal Committee
EIA	—	Environmental Impact Assessment
EMP	—	Environmental Management Plan
GAPA	—	Greater Aizawl Planning Area
GRC	—	Grievance Redress Committee
H&S	—	health and safety
IEE	—	initial environmental examination
IPCC	—	Investment Program Coordination Cell
lpcd	—	liters per capita per day
LCC	—	Local Council Chairman
MFF	—	Multitranche Financing Facility
MOEF	—	Ministry of Environment and Forests
MSW	—	municipal solid waste
NAAQS	—	National Ambient Air Quality Standards
NEA	—	national-level Executing Agency
NER	—	North Eastern Region
NERCCDIP	—	North Eastern Region Capital Cities Development Investment Program
NGO	—	nongovernmental organization
NSC	—	National level Steering Committee
O&M	—	operation and maintenance
PMIU	—	Project Management and Implementation Unit
PSP	—	private sector participation
SEA	—	State-level Executing Agency
SEIAA	—	State Environment Impact Assessment Authority
SIPMIU	—	State-level Investment Program Management and Implementation Units
SPS	—	Safeguard Policy Statement
TOR	—	terms of reference
UD&PAD	—	Urban Development & Poverty Alleviation Department
ULB	—	urban local body

WEIGHTS AND MEASURES

dbA		decibels
ha		hectare
km	–	kilometer
km2		square kilometer
l		Liter
M	–	meter
m2		square meter
M3		cubic meter
MT		metric tons
MTD		metric tons per day

NOTES

(i) In this report, "$" refers to US dollars.
(ii) “INR” and “Rs” refer to Indian rupees.

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EXECUTIVE SUMMARY

1. The North Eastern Region Capital Cities Development Investment Program (NERCCDIP) envisages achieving sustainable urban development in the Project Cities of Agartala, Aizawl, Kohima, Gangtok and Shillong through investments in urban infrastructure sectors. NERCCDIP will be implemented over a six-year period beginning in 2010, and will be funded by a loan via the Multitranche Financing Facility (MFF) of the Asian Development Bank (ADB).

2. The Ministry of Urban Development (MOUD) is the national Executing Agency. A State-level Investment Program Management and Implementation Units (SIPMIU) in each state are responsible for overall technical supervision and execution of all subprojects funded under the Investment Program. The SIPMIU is being assisted by: design, management and supervision consultants (DMSC), who are designing the infrastructure, managing the tendering of contracts, and will supervise construction.

3. ADB requires the consideration of environmental issues in all aspects of the Bank's operations, and the requirements for Environmental Assessment are described in ADB's Safeguard Policy Statement (SPS 2009). This states that ADB requires environmental assessment of all project loans, program loans, sector loans, sector development program loans, loans involving financial intermediaries, and private sector loans.

4. This Initial Environmental Examination (IEE) has been prepared for the Aizawl Solid Waste Management Subproject, specifically for the (i) improvement of the collection and transportation system; (ii) construction of garage and waste resource station; (iii) construction of landfill and associated facilities; and (iv) development of capacity.

5. An EMP is proposed as part of this IEE which includes (i) mitigation measures for significant environmental impacts during implementation; (ii) environmental monitoring program, and the responsible entities for mitigation, monitoring, and reporting; (iii) public consultation and information disclosure; and (iv) grievance redress mechanism. Mitigation measures have been developed to reduce all negative impacts to acceptable levels. A number of impacts and their significance have already been reduced by amending the designs. . During the detailed design, the IEE/EMP shall be further updated as a stand-alone EMP for each of the procurement packages and appended to the contract document.

6. The subproject site is located in vacant private land to be acquired by the government located adjacent to the existing dumpsite 20 kilometers outside the city. There are no protected areas, wetlands, mangroves, or estuarines. Trees, vegetation (mostly shrubs and grasses), and animals in the subproject site are those commonly found in built-up areas.

7. Potential negative impacts were identified in relation to construction and operation of the infrastructure. A number of impacts and their significance have already been reduced by amending the designs. Thus no impacts were identified as being due to the project design or location. Mitigation measures have been developed to reduce all negative impacts to acceptable levels.

8. During the construction phase, impacts mainly arise from the need to excavate large areas which can result to increase in dust and noise levels, disturbance to residents and businesses along the delivery routes, and traffic. These are common impacts of construction in built-up areas, and there are well developed methods for their mitigation.

9. It is proposed that the subproject retain a buffer zone (greenbelt) of 33% of the total land area to be planted with tall trees and endemic species; will employ in the workforce people who live in the vicinity of construction sites to provide them with a short-term economic gain; and ensure that people employed in the longer term to maintain and operate the new facilities are residents of nearby communities. Once the system is operating the hygienic environment of the city will be improved.

10. Mitigation will be assured by a program of environmental monitoring to be conducted during construction and operation stages. The environmental monitoring program will ensure that all measures are implemented, and will determine whether the environment is protected as intended. It will include observations on- and off-site, document checks, and interviews with workers and beneficiaries. Any requirements for remedial action will be reported to the SIPMIU. The main impacts of the operating the solid waste landfill and other subproject components will be beneficial to the citizens of Aizawl because they will be provided with a safe repository for non-biodegradable waste to serve the city population for 25 years.

11. The stakeholders were involved in developing the IEE through face-to-face discussions on site and public meeting held in the city, after which views expressed were incorporated into the IEE and the planning and development of the project. The IEE will be made available at public locations in the city and will be disclosed to a wider audience via the ADB website. The consultation process will be continued and expanded during project implementation, when a nationally-recognised nongovernment organization will be appointed to handle this key element to ensure that stakeholders are fully engaged in the project and have the opportunity to participate in its development and implementation.

12. Therefore the subproject is unlikely to cause significant adverse impacts. The potential adverse impacts that are associated with design, construction, and operation can be mitigated to standard levels without difficulty through proper engineering design and the incorporation or application of recommended mitigation measures and procedures. Based on the findings of the IEE, the classification of the Project as Category “B” is confirmed, and no further special study or detailed Environmental Impact Assessment needs to be undertaken to comply with ADB SPS (2009).

13. As per Government of India Environmental Impact Assessment (EIA) Notification (2006), the subproject is categorized as “B” requiring prior environmental clearance from the State Environmental Impact Assessment Authority (SEIAA). However, SEIAA in Mizoram has not yet been constituted therefore the Environmental Clearance have been obtained from the Ministry of Environment and Forest (MoEF), IA-III Division, New Delhi vide F.No.10-73/2010-IA.III Dated the 9th January, 2013.

I. INTRODUCTION

A. Purpose of the Report

1. The North Eastern Region Capital Cities Development Investment Program (NERCCDIP) envisages achieving sustainable urban development in the Project Cities of Agartala, Aizawl, Kohima, Shillong and Gangtok through investments in urban infrastructure sectors. The urban infrastructure and services improvement is proposed in the following sectors (i) water supply, (ii) sewerage and sanitation, and (iii) solid waste resource management. The expected impact of NERCCDIP is increased economic growth potential, reduced poverty, and reduced imbalances between the NER and the rest of the country. The expected outcomes of the Investment Program will be an improved urban environment and better living conditions for the 1.65 million people expected to be living in the NERCCDIP cities. To this end, NERCCDIP will (i) improve and expand urban infrastructure and services in the cities including in slums, and (ii) strengthen urban institutional, management, and the financing capacity of the institutions, including the urban local bodies. Based on considerations of economic justification, absorptive capacity and sustainability of the implementing agencies, sub-projects have been identified in each city in the priority infrastructure sectors.

2. Though NERCCDIP aims to improve the environmental condition of urban areas, the proposed improvements of infrastructure facilities may exert certain adverse impacts on the natural environment. While developing urban infrastructure facilities, impacts during the construction stage are expected to be more severe than impacts during the operation phase, though for a short duration. Exceptions being some facilities such as sanitary landfills and water treatment plants, which may also exert adverse impacts during the operation phase, if due care is not taken.

3. ADB requires the consideration of environmental issues in all aspects of the Bank's operations, and the requirements for Environmental Assessment are described in ADB's Safeguard Policy Statement (SPS 2009). This states that ADB requires environmental assessment of all project loans, program loans, sector loans, sector development program loans, loans involving financial intermediaries, and private sector loans.

4. This Initial Environmental Examination (IEE) has been prepared for the Aizawl Solid Waste Resource Management Subproject as part of NERCCDIP-Tranche 3. The subproject covers (i) improvement of the collection and transportation system; (ii) construction of composting plant; (iii) waste resource management center; (iv) Vermi-composting plant and; (v) capping of existing dumpsite; (vi) construction of landfill and associated facilities; and (vii) development of capacity building.

5. This IEE report covers the general environmental profile of Aizawl and includes an overview of the potential environmental impacts and their magnitude on physical, ecological, economic, and social and cultural resources within the subproject's influence area during design, construction, and operation stages. An Environmental Management Plan (EMP) is also proposed as part of this report which includes mitigation measures for significant environmental impacts during implementation of the Project, environmental monitoring program, and the responsible entities for mitigation and monitoring.

B. Extent of the IEE Study

6. This IEE report was prepared on the basis of detailed screening and analysis of all environmental parameters, field investigations and stakeholder consultations to meet the requirement s for environmental assessment process and documentation per ADB's SPS, 2009 and Government of India EIA Notification of 2006.

1. ADB Policy

7. ADB requires the consideration of environmental issues in all aspects of ADB's operations, and the requirements for Environmental Assessment are described in ADB SPS 2009. This states that ADB requires environmental assessment of all project loans, program loans, sector loans, sector development program loans, loans involving financial intermediaries, and private sector loans.

8. **Screening and Categorization**: The nature of the environmental assessment required for a project depends on the significance of its environmental impacts, which are related to the type and location of the project, the sensitivity, scale, nature and magnitude of its potential impacts, and the availability of cost-effective mitigation measures. Projects are screened for their expected environmental impacts are assigned to one of the following four categories:

(i) **Category A**. Projects could have significant adverse environmental impacts. An EIA is required to address significant impacts.
(ii) **Category B.** Projects could have some adverse environmental impacts, but of lesser degree or significance than those in category A. An IEE is required to determine whether significant environmental impacts warranting an EIA are likely. If an EIA is not needed, the IEE is regarded as the final environmental assessment report.
(iii) **Category C.** Projects are unlikely to have adverse environmental impacts. No EIA or IEE is required, although environmental implications are reviewed.
(iv) **Category FI**. Projects involve a credit line through a financial intermediary or an equity investment in a financial intermediary. The financial intermediary must apply an environmental management system, unless all Projects will result in insignificant impacts.

9. **Environmental Management Plan:** An EMP which addresses the potential impacts and risks identified by the environmental assessment shall be prepared. The level of detail and complexity of the EMP and the priority of the identified measures and actions will be commensurate with the Project's impact and risks.

10. **Public Disclosure**: ADB will post the following safeguard documents on its website so affected people, other stakeholders, and the general public can provide meaningful inputs into the project design and implementation:

(i) For environmental category A projects, draft EIA report at least 120 days before Board consideration;
(ii) Final or updated EIA and/or IEE upon receipt; and
(iii) Environmental Monitoring Reports submitted by SIPMIU during project implementation upon receipt.

2. National Law

a. EIA Notification (2006)

11. The Government of India EIA Notification of 2006 (replacing the EIA Notification of 1994), sets out the requirement for environmental assessment in India. This states that Environmental Clearance is required for specified activities/projects, and this must be obtained before any construction work or land preparation (except land acquisition) may commence. Projects are categorized as A or B depending on the scale of the project and the nature of its impacts.

12. **Categories A** projects require Environmental Clearance from the National Ministry of Environment and Forests (MOEF). The proponent is required to provide preliminary details of the project in the form of a Notification, after which an Expert Appraisal Committee (EAC) of the MOEF prepares comprehensive Terms of Reference (TOR) for the EIA study, which are finalized within 60 days. On completion of the study and review of the report by the EAC, MOEF considers the recommendation of the EAC and provides the Environmental Clearance if appropriate.

13. **Category B** projects require environmental clearance from the State Environment Impact Assessment Authority (SEIAA). The State level EAC categorizes the project as either B1 (requiring EIA study) or B2 (no EIA study), and prepares TOR for B1 projects within 60 days. On completion of the study and review of the report by the EAC, the SEIAA issues the Environmental Clearance based on the EAC recommendation. The Notification also provides that any project or activity classified as category B will be treated as category A if it is located in whole or in part within 10 km from the boundary of protected areas, notified areas or inter-state or international boundaries.

14. The only type of infrastructure provided by the NERCCDIP that is specified in the EIA Notification is solid waste resource management. However, SEIAA in Mizoram has not yet been constituted therefore the Environmental Clearance has been obtained from the MOEF, New Delhi.

15. The application for obtaining the Environmental Clearance was filed on 27 November 2010. Finalization of the TOR for the subproject was discussed with the EAC[1]. Meeting with Expert Appraisal Committee for the clearance was held in New Delhi. After finalization of the ToR, meeting with EAC[2] was held again in New Delhi and accordingly Environmental Clearance was issued on 9th Jan 2013, the clearance certificate is attached on Appendix 1.

b. Water (Prevention and Control of Pollution) Act (1974)

16. Any component of urban infrastructure project having potential to generate sewage or trade effluent will come under the purview of the Water (Prevention and Control of Pollution) Act, 1974. Such projects have to obtain Consent to Establish (CTE) under Section 25 of the Act

[1] 95th Meeting of the Expert Appraisal Committee for Building/Construction Projects/Township and Area Development Projects, Coastal Regulation Zone, Infrastructure Development and Miscellaneous Projects held on 18 to 20 January, 2011 at Conference Hall, Van Vigyan Bhawan, ICFRE, Sector-5, R.K. Puram, New Delhi.

[2] 115th Meeting of the Expert Appraisal Committee for Building Construction, Coastal Regulation Zone, Infrastructure Development and Miscellaneous Projects held on 16 to 17 August, 2012 at Scope Complex, Lodhi Road, New Delhi.

from Mizoram State Pollution Control Board before starting implementation and Consent to Operate (CTO) before commissioning. The Water Act also requires the occupier of such subprojects to take measures for abating the possible pollution of receiving water bodies. The municipal solid waste (MSW) processing plant and secured landfill under the sub project are required to comply with the provision.

c. Air (Prevention and Control of Pollution) Act (1981)

17. The subprojects having potential to emit air pollutants into the atmosphere have to obtain CTE under Section 21 of the Air (Prevention and Control of Pollution) Act, 1981 from Mizoram State Pollution Control Board before starting implementation and CTO before commissioning the project. The occupier of the project/facility has the responsibility to adopt necessary air pollution control measures for abating air pollution. If stone crushers, generators and other air pollution sources are to be established as part of the subproject, they will fall under the purview of the Air Act.

d. Municipal Solid Waste (Management and Handling) Rules (2000)

18. Government of India notified Municipal Solid Waste (Management and Handling) Rules (2000) in exercise of the powers conferred by Sections 3, 6 and 25 of the Environment (Protection) Act (1986) with the objective of regulating the management and handling of the municipal solid waste. Under the Rules, the municipal authority is required to take all steps to ensure that the municipal solid wastes generated in their jurisdiction are handled and disposed of without causing any adverse impact on human health or environment. The municipal authority or an operator of a facility shall obtain authorization for setting up waste processing and disposal facility (including landfills) from Mizoram State Pollution Control Board.

e. Forest Legislation

19. Forest legislation in India dates back to enactment of the Indian Forest Act, 1927. This Act empowers the State Government to declare “any forest land or waste-land, which is the property of Government or over which the Government has proprietary rights or to the whole or any part of the forest-product of which the Government is entitled”, a reserved forest or protected forest. The State Government may assign to any village-community the rights of Government over a reserved forest—those are called village-forests. Act also allows Government control over forest and lands not being the property of Government.

20. Acts like clearing or break up of any land for cultivation or for any other purpose, damage to vegetation/trees and quarrying or removing any forest produce from reserved forest is prohibited. All these are also applicable to village-forests. For protected forests, with the provision of the Act, the State Government makes rules to regulate activities like: cutting of trees and removal of forest produce; clearing or breaking up of land for cultivation or any other purpose; and for protection and management of any portion of protected forest.

21. Government of India Forest (Conservation) Act, 1980 (amended in 1988) restricts the deforestation of forests for use of non-forest purposes. According to the Act, State Government requires prior approval of Government of India for the use of forest land for non-forest purposes (means the breaking up or clearing of any forest land) or for assigning least to any private person or agency not controlled by government. The Forest (Conservation) Rules, 2003 issued under this Act, provide specific procedures to be followed for conversion of forest land for non-forest purposes.

22. Conversion of forest lands that are part of National Parks/Sanctuaries and Tiger Reserve areas (notified under Indian Wildlife (Protection) Act, 1972) is not permitted. In exceptional case, the State Government requires consent of the Indian Board of Wildlife for obtaining approval of the State Legislature for de-notification of the area as a sanctuary.

23. Cutting of trees in non-forest land, irrespective of land ownership, also requires permission from the Mizoram Forest Department. Afforestation to the extent of two trees per each tree felled is mandatory.

24. The following Consents, NOCs & Authorization are obtained for Solid Waste Resource management Sub – Projects and attach as appendix , which summarized in the Table – 1

Table 1- Status of Authorization, Consents & NOCs for the Project

Sr. No	Authorization, Consents & NOC's	Issued by	Date of Issue	Remarks
1	Environmental Clearance for the Engineering Landfill Site	Director IA – III Division , Ministry of Environment & Forest , Govt. of India	F.No. – 10 – 73\ 2010 – IA, III Dated 9 th Jan, 2013	Copy of Environmental Clearance is attached as appendix 1
2	Provisional Land Lease Certificate	Director Land revenue & Settlement, Govt. of Mizoram	Vide No. – K 15011 \ 138 \2012 – Rev Dt. 4.6.2014	Copy of Land Lease Certificate is attached as appendix 2
3	Tree felling permission for Land fill Site	Principal Chief Conservator of Forest Mizoram	Letter No. C. 18012\21\97 – PCCF(CON) 362 / Dated 19 th June 2011	A copy of NOC is attached as appendix 3
4	Consent for Establishment of Mechanical Composting Plant & Engineering Land Fill site	Member Secretary Mizoram state pollution Board	Letter No. H. 88088\ poltn\9\(154)\ 2011- MPCB\ Dated 19 th Oct 2014	Consent for establishment is attached as appendix 4
5	Consent for Establishment of Vermi – Compost Plant	Member Secretary Mizoram state pollution Board	Letter No. H. 88088\ poltn\9\(154)\ 2011- MPCB\307 Dated 14th Feb 2015	A copy of NOCs are attached as appendix 5
6	NOC from Aviation Department	Principal Consultant General Administration Department (Aviation Wing) Govt. Of Mizoram	Vide No. D.13020\ 01\ 2011 – GAD (AV) Govt of Mizoram	A copy of NOCs are attached as appendix 6

Table 2: Environmental Regulatory Compliance for Sub-project

Serial No	Component	Applicable Legislation	Action Required	Compliance
	All components that require Tree Felling	Forest (Conservation) Act, 1980	No Objection Certificate cum Tree felling permission from PCCF, Mizoram	Complied
	Land acquisition	R & R policy of Mizoram State Govt.	Provisional Lease certificate from Land & Revenue Department	Complied
	Municipal Solid Waste Facility including Land fill and Mechanical & Vermi – compost Plants	Municipal Solid Waste Management and Handling Rules (SWMHR), 2000; Water (Prevention and Control of Pollution) Act, 1974 and/or the Air (Prevention and Control of Pollution) Act, 1981.	Authorization from SPCB. No Objection Certificates (NOC), Certificates for Establishment (CFE) and Certificates for Operation (CFO).	SIPMU Authority received proper Authorization (CFE and CFO) from State Pollution Control Board (SPCB) for setting up waste processes and disposal Facility including landfill and compost plant.
	New Sanitary Engineering Landfill	EIA Notification, 2006 and as amended up-to-date promulgated under Environment Protection Act 1986	Environmental Clearance from SEIAA or EAC of MOEF (GOI)	The project is reviewed and clear by the EAC (MOEF) GoI as well as ensure environmental safeguards through its Municipal Solid Waste Management and Handling Rules (SWMHR), 2000 as published under MoEF.(Note: Mizoram State has no SEIAA).

SEIAA: State Environment Impact Assessment Authority, EAC: Environmental Appraisal Committee, GOI: Govt. of India, MOEF: Ministry of Forest & Environment (including Climate Change)

(i) Forest (Conservation) Act, 1980 (amended in 1988) enacted by Government of India, restricts the deforestation of forests for use of non-forest purposes. According to the Act, State Government requires prior approval of GoI for the use of forest land for non-forest purposes (means the breaking up or clearing of any forest land) or for assigning least to any private person or agency not controlled by government. The Forest (Conservation) Rules, 2003 issued under this Act, provide specific procedures to be followed for conversion of forest land for non - forest purposes.

(ii) Cutting of trees in non-forest land, irrespective of land ownership, also requires permission from the State Forest Department. Afforestation to the extent of three trees per each tree felled is mandatory.

(iii) Under the Water (Prevention and Control of Pollution) Act, 1974 and/or the Air (Prevention and Control of Pollution) Act, 1981, the following sub-projects require Consent for Establishment (CFE) and Consent for Operation (CFO) from the respective State Pollution Control Board (SPCB). The applicable forms, "FORM-1", to get the Consent for Emission/ Constitution of Emission under Section 21 of the Air (Prevention and Control of Pollution) Act 1981 and "FORM-A", Consent for Discharge under Section 25/26 of the Water Act, 1974 The CFE/CFO is issued upon project review and site visits. The Board issues the CFE before start of construction and the CFO after completion of construction and satisfying CFE conditions, if any. During the operation period, the effluent and air emissions must conform to the stipulated standards (CPCB Environmental Standards). The CFO is renewed every year based on the operation performance of the facility. The following sub-project component requires SPCB consent for establishment and operation.

- Mechanical compost Plant (under the Water Act);
- Vermi – compost Plant (under the Water Act);
- Solid waste Management and landfills (under the Water Act and the Air Act);
- At the state government level, solid waste subprojects require review by the respective State Pollution Control Board (SPCB). These subprojects are required to obtain the following clearances from SPCB: No Objection Certificates (NOC), Certificates for Establishment (CFE) and Certificates for Operation (CFO).

(iv) The new EIA Notification of 2006 of GoI, which replaces the EIA Notification of 1994, requires environmental clearance for certain defined activities/projects. This Notification classifies the projects/activities that require environmental clearance (EC) into 'A' and 'B' categories depending on the impact potential and/or scale of project. For both category projects, prior environmental clearance is mandatory before any construction work, or preparation of land except for securing the land, is started on such project or activity. Clearance provisions are as follows: (i) Category 'A' projects require prior environmental clearance from the MoEF, Government of India; (ii) Category 'B' projects require prior environmental clearance from the State Environment Impact Assessment Authority (SEIAA) 4; and (iii) This Notification provides that, any project or activity specified in Category 'B' will be treated as Category A, if located in whole or in part within 10 km from the boundary of (i) Protected Areas notified under the Wild Life (Protection) Act, 1972, (ii) Critically Polluted areas as notified by the Central Pollution Control Board from time to time, (iii) Notified Eco-sensitive areas, (iv) inter-State boundaries and international boundaries. Also, in the case where a SEIAA does not exist, Category B project will be reclassified as Category A and reviewed by the MoEF.

(v) Consequently, the only NERCCDIP subproject listed in the EIA Notification of 2006 Schedule of Projects Requiring Prior Environmental Clearance is solid waste facilities, otherwise referred to as Common Municipal Solid Waste Facilities (CMSWF). Common municipal solid waste management facilities qualify as Category B projects and are thus reviewed by the respective SEIAA. For solid waste facilities, the Government of India further ensures environmental

safeguards through its Municipal Solid Waste Management and Handling Rules (SWMHR), 2000 as published under MoEF.

(vi) This subproject focuses only on solid waste components. Therefore the construction of a sanitary landfill site (solid waste facility) qualifies the project as a Category B under Govt. of India law. The project is reviewed by the EAC (MOEF) Govt. of India as well as ensure environmental safeguards through its Municipal Solid Waste Management and Handling Rules (SWMHR), 2000 as published under MoEF.(Note: Mizoram State has no SEIAA).

(vii) Limited sub-projects notably solid waste composting and landfills may require acquisition of private land5. The Government of Mizoram Land & Revenue Department has officially handed over to use the land for solid waste disposal purposes for the existing and proposed solid waste disposal site

II. DESCRIPTION OF THE PROJECT

A. Type, Category and Need

25. **Type:** This is a solid waste resource management subproject intended to improve the current situation in Aizawl in terms of providing a disposal area, improving the collection system, and raising the awareness of the community of their responsibility to place their waste at collection points, and to segregate waste that is suitable for recycling.

26. **Category**: Environmental examination indicates the proposed subproject falls within ADB's environmental Category B projects. The Project components will only have small-scale, localized impacts on the environment, and can be mitigated. Under ADB procedures such projects require an IEE to identify and mitigate the impacts, and to determine whether further study or a more detailed EIA may be required.

27. **Need**: The subproject is needed because the present solid waste infrastructure in Aizawl is inadequate for the needs of the growing population. There are inadequate collection points and people deposit their solid waste on open grounds and drains where it creates unhealthy environment and produces health hazard. The existing solid waste management is open dumping on at Tuirial which is causing a nuisance for the localities'.

28. The primary objective of the subproject is to upgrade the existing solid waste management services to make them scientific and more efficient and to adopt sanitary land filling for ultimate disposal as per Municipal Solid Waste (Management and Handling) Rule (MSW Rules) (2000) in the interests of health and economic well being of the people of Aizawl. The other objective is to provide the long term (till 2041) solution of the problem of solid waste management by way of (i) modernization of the system through modern household and community bins for separate collection of biodegradable and non-biodegradable wastes, and recyclables, closed body transportation of garbage; (ii) provision of composting plant with necessary facilities; (iii) provision of vermi – composting plant; (iv) capping of existing dumpsite; (v) provision of engineered landfill complete with equipment; and (vi) development of capacity for effective public participation in waste segregation.

B. Location

29. The landfill and associated infrastructure will be constructed near the existing dumpsite in Tuirial, 20 kilometers (km) from the city. The selected site has a total area of 15 hectares (ha), 5 ha of which is government-owned land and the remaining 10 hectares acquired from private

owners by the Government in 2010. The provisional land lease certificate is attached in APPENDIX 2. The resource management center and garage will be constructed within the proposed landfill site. There is no human habitation within the 4 km boundary radius of the landfill site.

30. The existing dumping site will be closed scientifically so as to minimize the impact on environment.

31. Waste carrying vehicle will be deployed for collecting biodegradable and non-biodegradable waste separately. The collection timing will be as per convenience of the localities and traffic. These vehicles will be covered so as to ensure that there is no spillage on the roads.

C. Description of the Subproject

1. Existing Solid Waste Management

32. **Management**: The Aizawl Municipal Council (AMC) is currently undertaking the solid waste management of Aizawl city. The AMC has sanitation wing which is handling waste collection from household and sending into disposal site. The practice is carried out in a public private partnership mode (PPP mode).

33. The Local Councils from each locality are assigned by AMC to look after the collection system of waste. They are active in taking responsible actions towards maintaining public health, law, and order. They organize sanitation works through hnatlang (public participation). The local Councils, as revealed during the consultations and discussions, maintain a close watch on solid waste management activities carried out by Sanitation Wing within their respective localities, and provide inputs to the sanitation officer on a regular basis for the improvements required or deficiencies, if any.

34. **Waste Generation:** At present 159.88 metric tons per day (MTD) of solid waste is generated within the city. The major solid waste generation sources are households (55%), commercial (20%), hospitals (1.5%), small industries (7 to 10%), hotels and restaurants (3.5%), and construction and demolition activities (2.5%).

35. **Collection and Transportation System**: In Aizawl, solid wastes are collected through (i) Street sweeping, and (ii) waste carrying vehicles from sanitation collection points (picture from appendix 12). Only 40-45% of waste generated is collected. No waste storage facilities or storage bins are in existence. The fixed masonry bins, previously used for storage of wastes, being in a very bad condition, have been demolished. New bins as alternatives to these have not been provided, for lack of funds. In such a situation, sweepers accumulate waste along roadside collection points. Households also dispose their waste at these points. The accumulated waste is then manually loaded to refuse vehicles. Allocation of sweepers and refuse vehicles is usually done by sanitary inspectors. The timings for sweeping and waste collection are normally from 6.00 a.m. to 12 noon, which extends to 1 p.m. in winter.

36. Frequency of waste collection is not uniform throughout the city. The service is more frequent in accessible and densely populated core areas compared to other inaccessible areas. The waste from inaccessible areas are either burnt or dumped on open areas, roadsides, valleys and streams. Regular waste collection service has been observed at central and eastern part of the city, while north of Aizawl is attended on weekly or bi-weekly basis.

37. Waste collected is transported through uncovered refuse vehicles, which lead to waste spillage. The loading and unloading of refuse vehicles is done manually through the respective allotted sweepers and sanitary workers. Manual loading and unloading is time consuming and reduces waste carrying efficiency in terms of lesser trips. This practice also increases health risk of workers. The average waste carrying capacity of each of the refuse vehicles is 1.86 to 2.56 metric tons (MT) per trip. With this capacity, it is estimated that a total of 45 MTD of waste can be transported, if all vehicles are in use and make 1 trip daily. On an average, vehicles cover 45 to 50 km per trip from collection point to disposal site.

38. **Segregation:** A pilot project for waste segregation is taken up for improvement and demonstration of best practice on solid waste management. The pilot project covers 5 local council areas i.e. Laipuitlang, College Veng, Nursery Veng, Chawnpui and Kanan Veng within Aizawl Municipal Council. These areas are middle class area with majority household and with better economic background. From this place, solid waste is collected in segregated manner.

39. The Process or Methodology adopted for pilot project is given below:

- Educate and motivate the local people
- Door to door waste collection
- Segregation of biodegradable and Non-biodegradable wastes at sources.
- Transportation in segregated manner to land fill site.

40. **Dry Waste secondary segregation resource centre at Tuirial** : Dry wastes from household is collected and transported to secondary segregation point at Tuirial to sort out the waste such as Plastic, Metal, Glass, Paper etc. for recycle by 6 rag picker employed by Aizawl Municipal Council and sale.

41. **Wet Waste to vermicomposting at Lengpui**: Segregated Wet Waste from Household is collected and transported to Vermicomposting unit at Lengpui to produce high quality manure with the help of earthworm (Eisenia foetida and Perionyx excavates).

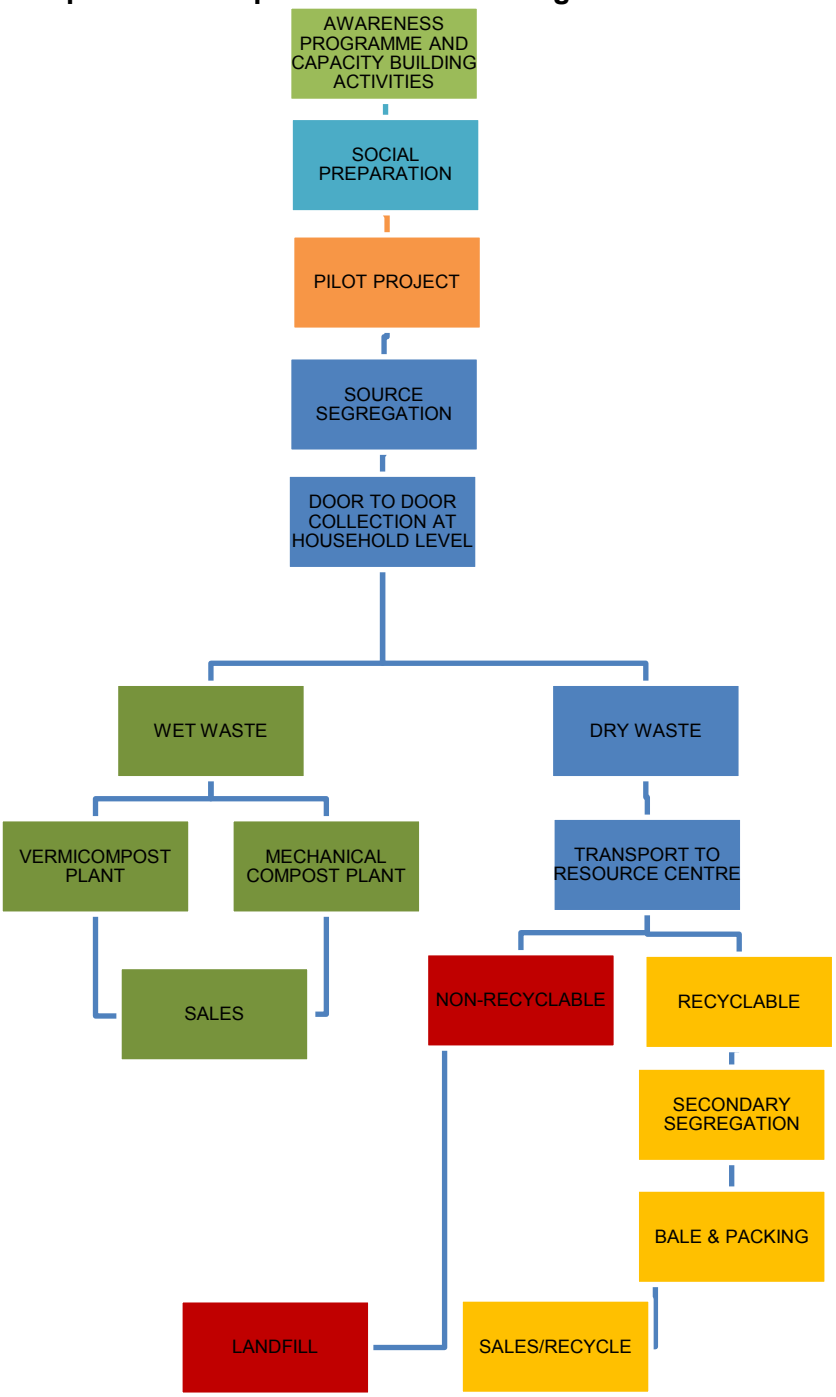
42. **Under Construction Incineration Unit at Tuirial Waste Dumping Site:** At present waste dumping site, an Incineration Unit is under construction by Aizawl Municipal Council for Bio – Medical Waste generated in GAPA having the capacity of 1 ton per day at pilot basis. The construction work will be completed within month of May 2015 and which is likely to be operational from June 2015.The CPCB Environmental Quality Monitoring Standards for waste incineration under Municipal Solid Waste Rule 2000 & Biomedical Waste (Management & Handling) Rules 1998 are adopted for the monitoring system of the under constructed incineration unit. For untreated waste storage and disposal of end or by product Aizawl municipal Council temporally construct a storage garage and fill cell at present Tuirial dump site the authorised letter from the Aizawl Municipal Council is attached in APPENDIX (10 A) & (C).

43. **Disposal:** Wastes collected are dumped at Tuirial disposal site, 20 km away from city and adjacent to NH-54. (See picture from Appendix 12) The site is in use from the last 8 years. In the absence of a treatment facility all the waste are dumped openly. The disposal process does not follow any sanitary land filling method. This leads to garbage littering and waste burning, which poses threat to public health and environment. Other associated ill effects from open disposal at Tuirial are: (i) contamination of nearby stream (joining Tuirial River) due to leachate formation; and (ii) health hazard to workers involved in manual handling of wastes. In the absence of a weighbridge at the disposal site, the quantity of wastes transported to the site is not known.

44. **The Proposed SWM Plan** is broadly based on the 4R Environmental Protection Rules (Reduce, Recycle, Reuse, and Recover) and is in accordance with the MSW 2000 Rules. The primary aspects of the proposed plan include the following

- Compliance with Municipal Solid Waste (Management & Handling) Rules, 2000
- Segregation at source
- Provision of segregated infrastructure at all stages of collection and transportation
- Waste to be covered at all stages of handling
- Elimination of manual handling of waste and the provision of proper PPEs to the workers
- 100% collection and transportation of the generated waste
- Maximum recovery of resources by segregating recyclables and biodegradable
- Advocate 4R's i.e. reduce, recycle, reuse, and recover materials through MSW management
- Adopt proven technologies for waste processing
- Promote information, education and communication to ensure system efficiency and sustainability
- Ensure economic sustainability of the proposed system by introducing PPP in MSW management
- Adequate health and safety provisions for workers at all stages of waste handling
- Regular environmental monitoring at waste processing and disposal facilities
- Have robust complaint-handling system in place
- Conduct regular internal and external independent audits on the efficiency of the entire SWM system

Figure 1: Proposed Municipal Solid Waste Management Plan for Aizawl City.



45. A pilot project was taken up community action plan for solid waste management by Aizawl municipal council with the help of SIPMU. In this solid waste management is carried out on pilot basis, so that a successful model could be replication on a larger scale. The pilot project would be tested in 5 local council area i.e. Laipuitlang, College Veng, Nursery Veng, Chawnpui and Kanan Veng within Aizawl Municipal Council. These areas are middle class area with

majority household of with better economic background. From this place, solid waste should be collected in segregated manner. The main objective of pilot project was:

(i) To promote understanding of different kinds of waste and separation of waste at source.

(ii) To educate and motivate the local people of Pilot Area with regarding conservation of solid waste to useful purpose

46. The methodology adopted for pilot project was;

- Door to door waste collection
- Segregation of biodegradable and Non-biodegradable wastes at sources.
- Transportation in segregated manner to land fill site.
- Dry wastes from household will be collected and transported to secondary segregation point at Tuirial to sort out the waste such as Plastic, Metal, Glass, Paper etc. for recycle and sale.
- Segregated Wet Waste will be transported to Vermi-composting plant site at Lengpui, about 34 km from Aizawl towards Lengpui Airport.

Table 3: The gap address by completed pilot project is given below:

Sr. No	The existing situation of Solid Waste Management in 6 selected Pilot Area	The situation of Solid Waste Management in 6 selected Pilot Area during completed project
1	Disposal of Solid Waste entrusted to the Local Councils through fund provided by the Aizawl Municipal Council (AMC) and Public contribution in the ratio of 90:10	Disposal of Solid Waste entrusted to the Local Councils through fund provided by the Aizawl Municipal Council (AMC) and Public contribution in the ratio of 100:00
2	No door to door collection	Door to door waste collection
3	No Waste segregation	Segregation of biodegradable and Non-biodegradable wastes at sources.
4	Absence of scientific disposal	scientific disposal viz Dry wastes from household will be collected and transported to secondary segregation point at Tuirial to sort out the waste such as Plastic, Metal, Glass, Paper etc. for recycle and sale. Segregated Wet Waste will be transported to Vermi-composting plant site at Lengpui, about 34 km from Aizawl towards Lengpui Airport.

2. Subproject Components

47. The subproject covers (i) improvement of the collection and transportation system; (ii) Construction of composting and vermi-composting plant; (iii) sanitary landfill site; (iv) Leachate Management (V) construction of waste resource management centre; (vi) closure of existing dumping ground and (vii) capacity building.

48. **Improvement in Collection System:** This will be done by providing dustbins and wheelbarrows and through intensive community awareness and consultation program. The components proposed include:

(i) Introduction of house-to-house waste collection through segregation at source. Targeted initially to about 66,094 households within the Aizawl Municipal Council (AMC) area;[2]
(ii) Provision of 148 units of wheelbarrows to be used by sweepers in the central areas of the city;
(iii) Provision of safety mask, gloves, boots, shovel, dust pan, broom and uniform for the safai karamcharis and street sweepers.

49. **Improvement in Transportation Facilities:** This will be done by operational improvements of the existing refuse vehicles through incorporation of more vehicles with proper tipping and hydraulic loading/unloading arrangements. The components proposed include:
(i) Provision of 4 Mahindra pick-up (1.5 cum capacity) for collecting the wastes from house-to-house with introduction of bell ringing system and covered (to be used in areas where access for medium truck is not possible).
(ii) Provision of 50 medium vehicle tipper (3.5 cum capacity) for collecting the waste from house-to-house with introduction of bell ringing system (to be used in households along main roads).

50. **Construction of Waste resource management center**. The waste resource management and garage will be constructed within the proposed landfill site. It is proposed to provide the basic infrastructure of proper road access, fence, and gatehouse with weighbridge, office, stores, workers room, toilet facility, green belt/buffer zone, water supply etc.

51. **Construction of Composting Plant and Vermi – Composting.** A composting and vermi-composting plant will be constructed at Tuirial about 20 Km from the city. . A direct 7.5 m wide road of about 900 m length to connect the landfill site with the highway is being planned and internal road of 380m.A green screen of local flowering plant spices is also develop for odour control.

52. **Capping of Existing Dumpsite.** The capping of existing dumpsite has to be designed, constructed and operated in such a manner that the waste is not allowed to come out and its migration to the ground water through permeation or diffusion can be stopped. This can be achieved through provision of liner on top and sides and proper storm water removal mechanism. Guidelines for capping, Ministry of Environment and Forest, 1991 specifies that capping must have a liner system and a storm water management system. The liner system must have a liner that is designed and constructed to prevent any migration of wastes out of the dumpsite to the adjacent sub-surface soil or ground water at any time during the closure and post closure period. The liner also must have appropriate chemical properties and sufficient strength to prevent failure.

53. The guidelines further specify that the following minimum liner system.
(i) A surface soil layer of local top soil which supports self-sustaining vegetation and which has thickness not less than 60 cm.
(ii) A drainage layer of thickness 30 cm or more having a coefficient of permeability in excess of 10-2 cm/sec

[2] To ensure segregation at source community awareness campaign, house-to-house surveys, and different-day waste collection for dry and wet wastes will be taken up in 5 pilot localities. The results of the pilot study will be replicated in remaining AMC area.

(iii) A composite liner comprises a HDPE geo-membrane of thickness 1.5 mm and a compacted clay layer of 60 cm thick or more having coefficient of permeability of - 10- 7 cm/sec or less.

(iv) A regulatory layer (optional) of thickness 30 cm having coefficient of permeability of the local top soil, if the coefficient of permeability of the local top soil is greater than 10-4 cm/sec.

(v) The horizontal surface of the final cover shall be provided a slope of 3 to 5% for proper surface water drainage.

54. Guidelines specify that the HDPE geo-membrane must have tensile strength at yield > 18 kN/m, Tensile strength at break > 30 kN/m, tear resistance > 150N and puncture resistance > 250 N.

55. The State Pollution Control Board will monitor the implementation.

Table: 4 Compliance with MOEF (GOI) Guidelines with proposed Design for Capping of Existing Dump site.

Sr.No	Guidelines for capping, Ministry of Environment and Forest, 1991	Proposed Design for Capping of Operational Dump Site	Remarks
1	A surface soil layer of local top soil which supports self-sustaining vegetation and which has thickness not less than 60 cm.	A surface soil layer of local top soil which supports self-sustaining vegetation and which has thickness not less than 60 cm.	Compiled
2	A drainage layer of thickness 30 cm or more having a coefficient of permeability in excess of 10-2 cm/sec	A drainage layer having a coefficient of permeability in excess of 10-2 cm/sec.	Compiled
3	composite liner comprises a HDPE geo-membrane of thickness 1.5 mm and a compacted clay layer of 60 cm thick or more having coefficient of permeability of - 10- 7 cm/sec or less.	A single composite liner comprising of: A HDPE geo membrane of thickness 1.5mm. Compacted clay (or compacted amended soil) layer of thickness 600 mm having a coefficient of permeability of 10-7 cm/sec.	Compiled
4	A regulatory layer (optional) of thickness 30 cm having coefficient of permeability of the local top soil, if the coefficient of permeability of the local top soil is greater than 10-4 cm/sec.	Gas collection layer (regulatory layer) of 30 cm having coefficient of permeability of more than 10-2 cm/sec. Embedded with perforated HDPE pipes	Compiled
5	The horizontal surface of the final cover shall be provided a slope of 3 to 5% for proper surface water drainage.	The horizontal surface slope is provided as 3%.	Compiled
6	HDPE geo-membrane must have tensile strength at yield > 18 kN/m, Tensile strength at break > 30 kN/m, tear resistance > 150N and puncture resistance > 250 N.	The composite liners shall consist of a HDPE sheet of 1.5 mm thick	Compiled
7	Storm water drainage	The storm water drains of 600 mm x 600 mm size on the perimeter of the landfill i.e. at the toe of the embankment to be provided. The slope of 3% in the dome of the cap provides adequate slant to the	Compiled

Sr.No	Guidelines for capping, Ministry of Environment and Forest, 1991	Proposed Design for Capping of Operational Dump Site	Remarks
		rainwater to get collected in the storm water drains located on the toe of the embankment. The toe drains are connected to the existing drains. Storm water will be disposed off through existing drainage system.	

56. **Capping Linear Design for Closure Scheme of Existing Dump Site**: The capping liner system should be able to prevent migration of rain water into constituents of MSW and should also fulfil the existing rules and guidelines for design of capping system. In line with the Guidelines for capping of SEPs, Ministry of Environment and Forest, 1991 and USEPA Minimum Technological Requirements described earlier, the following liner system is proposed. The components listed below are from top surface downwards to the waste.

(i) A surface soil layer of local top soil which supports self-sustaining vegetation and which has thickness not less than 60 cm.

(ii) A drainage layer having a coefficient of permeability in excess of 10-2 cm/sec.

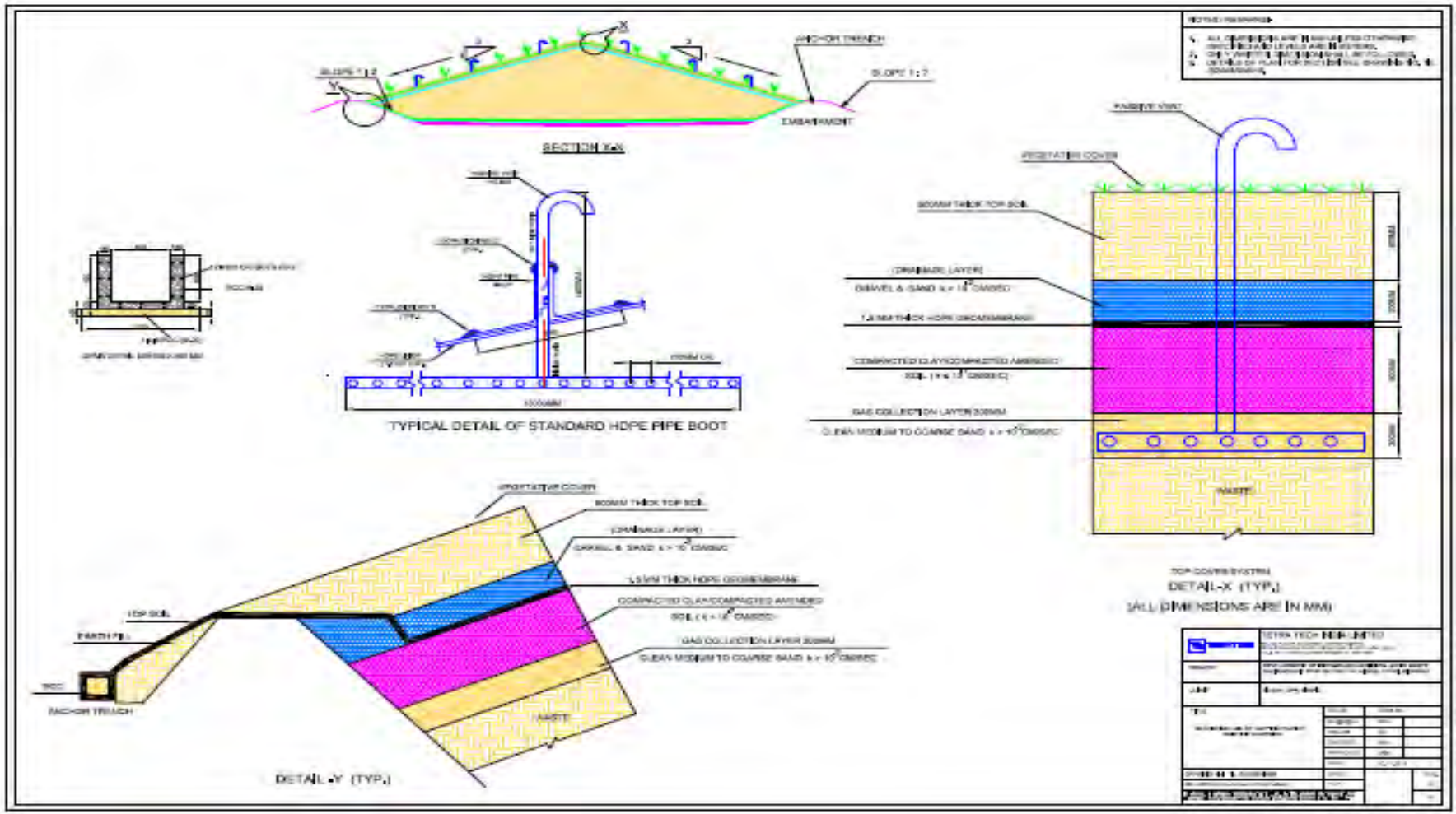
(iii) A single composite liner comprising of:

- A HDPE geo membrane of thickness 1.5mm
- Compacted clay (or compacted amended soil) layer of thickness 600 mm having a coefficient of permeability of 10-7 cm/sec.

(iv) The horizontal surface slope is provided as 3%.

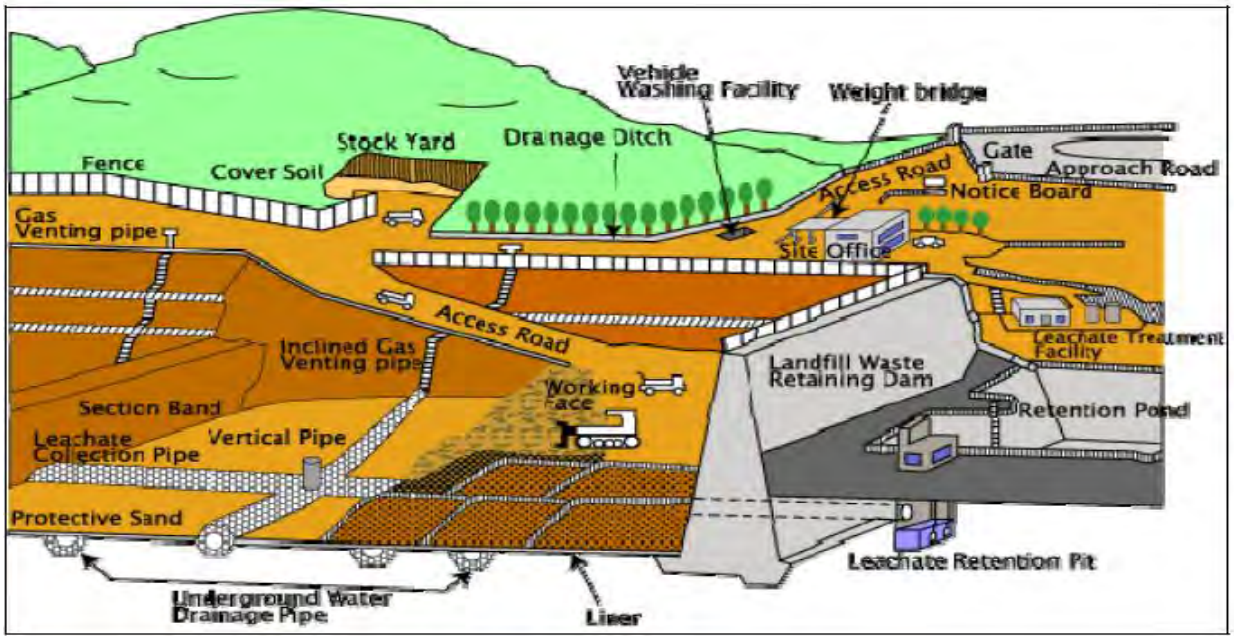
(v) A gas collection layer (regulatory layer) of 30 cm having coefficient of permeability of more than 10-2 cm/sec. Embedded with perforated HDPE pipes. After Capping the existing dumping site is used as a public premise with consultation with Aizawl Municipal Council attached in APPENDIX 10(B).

Figure 2: Section details of Capping Plan of Existing Waste Dump Site



57. **New Landfill Site at Tuirial.** The existing is proposed to be closed after commissioning of the landfill. The proposed landfill site will be located at Tuirial which is 20Km away from the city, adjacent to NH-54. The aerial distance from Lengpui Airport is 20.73Kms, No objection certificate from General Administration Department – Aviation Wing has been obtained (See Appendix 6). Preliminary design & engineering has been done for the construction of sanitary landfill facility for Aizawl. This facility shall comprise of a secured landfill facility (SLF) and other associated facilities. The construction of landfill shall be taken up into five phases. Each phase will serve for approximately 5 years. After filling of each phase, it will be covered with top cover and subsequently filling of waste in the next phase area will be started. The integrated landfill facility shall require around 23026 sq.m of area to accommodate the landfill able waste for 5 years in Aizawl. The Total Life of landfill is also worked out for 25 years. The base of landfill i.e. top of liner has been kept at ground level 286 m and 3 m high (above GL) earthen embankment has been provided to achieve the required storage capacity within the area available. Top width of the embankment has been kept at 3 m. Inner & outer slopes of the embankment have been kept at 1V: 2H for stability of slopes. The geo-composite liner has been provided on the inner side of the landfill as per the requirement of Central and State Pollution Control board norms. Leachate collection system has been provided at the base of the landfill with 250 mm dia. HDPE header and 110 mm dia. perforated HDPE lateral pipes. Leachate shall be collected in the Leachate collection sump from where it will be pumped to leachate holding tank. Leachate transfer pumps shall be provided of adequate capacity. MSW shall be dumped in the landfill by refuge collector cum compactor, which shall be further levelled and compacted. Periodic waste audits will ensure that non-conforming waste shall not be dumped at the landfill site. The waste shall be compacted in thin layers using compactors and covered with a daily cover of soil layer or inert waste. After the landfill is filled it will be covered with top cover system with single liner arrangement and on the top, 450 mm thick surface layer (Top Soil) shall be provided with vegetation. The slope of top cover shall be kept as 4% to provide quick drainage of surface runoff. For ground water monitoring, 4 Nos. of wells shall be provided. A suitable ramp to reach the embankment top shall be provided so that refuge collector cum compactor can reach the top of embankment and can directly dump the municipal solid waste in the landfill.

Figure 3: Proposed Landfill Site Anatomy

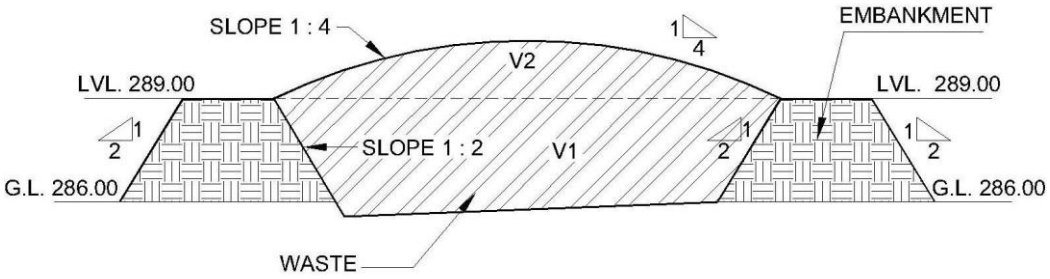


58. **Construction of a Landfill & Capacity:** The site will be protected around by retaining walls and turfing on steep slopes. The rainwater will be collected by storm drains and then subsequently aligned to the main natural drain down the valley to control erosion and landslides. The site will also be provided with a buffer zone of 20 m wide greenbelt.

59. The sketch showing section of landfill is given below for the estimation of landfill capacity (figure 8.1). The capacity of landfill is worked out by considering mainly three parts of landfill which are as follows:

(i) Middle part (V1)
(ii) Bottom part in the slope of header pipe (V2)
(iii) Top portion (V3)

Figure 4: Proposed Landfill Anatomy sketch



60. The step wise calculation for the estimation of capacity of landfill and design life : (Active Period = 16 years, Closure and post closure period = 25 years) is given in the below:

a. Current Waste Generation (2015) = 159.88 tonnes per day
b. Current Waste Going to landfill @19.59% = 0.1959 x 159.88
= 31.32 TPD
c. Proposed life of Landfill = 16 years
d. Estimated Waste generation after 25 years@16.74% = 0.1959 x 342.91 TPD
= 61.17 TPD
e. Total Waste generation in 25 years = 0.5 (31.32+61.17) x 365 x 25
= 421985 MT
f. Total Waste Volume (assuming density of 1.10 ton/cum)
V_w = 421985/1.10
= **383622 m^3**
g. Volume of Daily Cover V_{dc} = 0.1 x 383622
= **38362 m^3**
h. Volume of Linear and cover System (on the assumption of 1.1 m thick liner system (including leachate collection layer) V_c = 0.11 x 38362
= **4219 m^3**
i. Volume likely to become available within 10 years due to settlement/biodegradation of Waste (assuming m = 0.125). V_s = 0.05 x 383622 m^3
= **19181 m^3**
j. First Estimate of landfill Volume C_i = $(V_w + V_{dc} + V_c - V_s)$
= (383622+38362+4219 - 19181) = **407022 m^3**
k. Likely shape of landfill : Rectangular in Plan (length: width = 2:1)
l. Possible Minimum Landfill height = 10 m
m. Area required = 407022/10

= 40702 sq.m.
= 4.07 hectares

n. Approximate plan Dimensions = 286 m x 143 m
o. Total Area required (including infrastructural facilities) = 1.15 x 40702
= **46807.30 sq.m**.

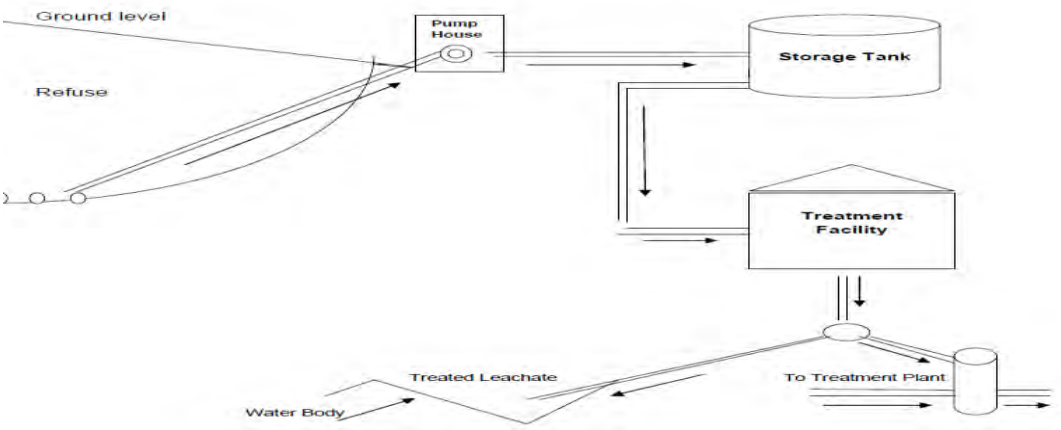
Calculation of Capacity of Landfill for the first Five years for estimation purpose

i. Current Waste Generation (2015) = 159.88 tonnes per day
ii. Current Waste Going to landfill @19.59% = 0.1959 x 159.88
= 31.32TPD
iii. Proposed life of Landfill = 5 years
iv. Estimated Waste generation after 16 years@16.74% = 0.1959 x 188.54 TPD
= 36.93 TPD
v. Total Waste generation in 16 years = 0.5 (31.32+ 36.93) x 365 x 5
= 62278 MT
vi. Total Waste Volume (assuming density of 1.10 ton/cum)
V_w = 62278/1.10
= **56616 m^3**
vii. Volume of Daily Cover V_{dc} = 0.1 x 56616
= **5661 m^3**
viii. Volume of Linear and cover System (on the assumption of 1.1 m thick liner system (including leachate collection layer) V_c = 0.11 x 5661
= **622 m^3**
ix. Volume likely to become available within 10 years due to settlement/biodegradation of Waste (assuming m = 0.125). V_s = 0.05 x 56616 m^3
= **2830 m^3**

x. **First Estimate of landfill Volume (first 5 years)** $C_i = (V_w + V_{dc} + V_c - V_s)$
= (56616+5661+622 -2830) = **60069 m^3**
xi. Likely shape of landfill : Rectangular in Plan (length: width = 2:1)
xii. Possible Minimum Landfill height = 3 m
xiii. Area required = 60069/3
= 20023sq.m.
= 2.00 hectares
xiv. Approximate plan Dimensions = 215 m x 108 m
xv. Total Area required (including infrastructural facilities)= 1.15 x 20023
= **23026 sq.m**.

61. **Leachate Collection and Removal System:** Leachate is generated due to exposure of uncovered waste to the precipitation and will be collected and treated to prevent contamination of groundwater. The main components of the leachate collection systems are feeder main and leachate collection sump. A minimum size of 110 mm high density polyethylene (HDPE) pipes is recommended for feeder pipe. Similarly header pipes are designed to take the flow from feeder pipe and a minimum size of 160 mm is recommended with spacing at 25 mm. A main pipe of 450 mm dia connected inside with submersible pump to pump leachate. A 200 mm thick graded pebble and 100 mm thick sand layer is provisioned as drainage layer to facilitate the removal of leachate. The dimension of leachate collection sumps is worked out to be with 5.0 m dia x 2.5 m height.

Figure 5: Proposed Leachate Management System



62. **Leachate Treatment Plant:** It is estimated that the landfill generates about 52.30 m3\ day of leachate. The quality of leachate is a function of waste characteristics and climatic conditions, especially precipitation. Treatment of the same involves a combination of technologies. Since the characteristics of leachate vary with time and town and also based on the type of waste disposed off in the landfill conventional treatment technology of Facultative aerated lagoon (FAL) is suggested. Proposed treatment capacity of the FAL is 52.30 m3/day.

63. Based on the volume of leachate that was predicted to be generated, it was deemed feasible to build a leachate collection tank that would contain the entire annual generated leachate. The leachate collection tank shall be provided outside the embankment. These shall be located 0.5 m above the lowest ground level. The leachate collection layer is provided in the granular soil (drainage) layer of the bottom liner system. The collection layer shall comprise of a network of perforated HDPE lateral pipes laid at a slope of 2% and 20 m c/c spacing. These laterals collect leachate and transfer it to the HDPE header pipe, which is laid at a slope of 1%. The header pipe ultimately transfers the leachate into the leachate collection sump. The conveyance system has been designed for a lesser flow that will come with time and that also at a very slow rate, therefore lateral pipe of 110 mm and header pipe of 250 mm are provided for leachate collection and removal. Sludge to be generated from the FAL will be disposed in designated cells in the landfill. A sludge management plan will be developed as part of the O&M manual of the subproject. For ground water monitoring, 4 Nos. of wells shall be provided.

64. **Landfill Associated Facilities.** It is proposed to provide the basic infrastructure of proper road access, fence, and gatehouse with weighbridge, office, stores, workers room, toilet facility, washing and toilets for staff, green belt/buffer zone, water supply, lighting etc. The associated facilities are given below.

(i) Approach road and internal roads
(ii) Storm water drains
(iii) Tyre washing facility.
(iv) Green Buffer development.
(v) Compound wall and boundary fencing
(vi) Tipping area.
(vii) Main entrance gate
(viii) Weigh bridge
(ix) Office cum laboratory.
(x) Administrative office building/weighbridge operator’s room

(xi) Common toilets and septic
(xii) Security guard's room
(xiii) Bore well with steel casing
(xiv) In addition to above an open area of about 1,200 m2 is earmarked for waste segregation and recycling. Vehicle washing area and vehicle parking area are also earmarked.
(xv) Water reservoir
(xvi) Godown / Sales emporium.
(xvii) Electrical works for street lighting and internal lighting.

65. The base of landfill i.e. top of liner has been kept at ground level 286 m and 3 m high (above GL) earthen embankment has been provided to achieve the required storage capacity within the area available. Top width of the embankment has been kept at 3 m. Inner & outer slopes of the embankment have been kept at 1V: 2H for stability of slopes. The geo-composite liner has been provided on the inner side of the landfill as per the requirement of Central and State Pollution Control board norms. Leachate collection system has been provided at the base of the landfill with 250 mm dia. HDPE header and 110 mm dia. perforated HDPE lateral pipes. Leachate shall be collected in the Leachate collection sump from where it will be pumped to leachate holding tank. Leachate transfer pumps shall be provided of adequate capacity.

66. MSW shall be dumped in the landfill by refuge collector cum compactor, which shall be further levelled and compacted. Periodic waste audits will ensure that non-conforming waste shall not be dumped at the landfill site. The waste shall be compacted in thin layers using compactors and covered with a daily cover of soil layer or inert waste. After the landfill is filled it will be covered with top cover system with single liner arrangement and on the top, 450 mm thick surface layer (Top Soil) shall be provided with vegetation. The slope of top cover shall be kept as 4% to provide quick drainage of surface runoff. For ground water monitoring, 4 Nos. of wells shall be provided. A suitable ramp to reach the embankment top shall be provided so that refuge collector cum compactor can reach the top of embankment and can directly dump the municipal solid waste in the landfill.

67. Post closure care involves the routine inspection of the completed landfill site, maintenance of infrastructure and environmental monitoring. A well-defined closure plan shall be formulated for effective implementation

68. **Development of Capacity**. This will consist of (i) safeguard compliance studies; (ii) community awareness programs; and (iii) private sector participation opportunities study. The basic approach of Capacity Building is to bring effectiveness to the existing Solid Waste Management System in Aizawl town and to increase operational efficiency of the sanitary staff of AMC. AMC has appointed many officials & sanitary staff for waste management in the town. To know their knowledge, to judge their efficiency, a baseline data would be collected through questionnaire survey, structured interviews of the ULB staff. On the basis of the findings of the study, training programmes and training schedule would be prepared for different levels of the ULB staff. Training & Capacity Building programme would be planned and workshops would be organized for imparting training to the official. The primarily focus of the training would be on institutional development. For preparing training module, existing institutional framework would be studied along with the respective roles and activities of each stakeholder. The identification of roles and responsibilities of the implementing body (AMC) and stakeholder would help us to identify and improve various components of the institutional framework for the sustainability of the system.

69. The major objectives of the Capacity Building are as follows:

- Bringing of attitudinal and behavioural changes among the residence w.r.t. the segregation of waste and sanitation improvement.
- Public awareness through IEC programmes and educating the masses on various aspects of solid waste management and achieve the target of receiving segregated waste from each household.
- Creating Public Participation in Planning and Management of MSW Activities
- Capacity Building of the personnel involved in implementing MSW i.e. Institutional Capacity of Sanitary and Health Department of AMC for improved MSW Management.
- Integration and involvement of private sweepers and rag pickers in improving MSW management

70. **Methodology for Conducting Training Programme**. Awareness is to be created on how to handle the waste, ensuring complete participation, consultation and commitment from all stakeholders at all levels w.r.t. efficient and effective segregation at generator level as well as for workers handling waste at primary and secondary level. Awareness on usage of safety equipment and Personal Protection Equipment (PPEs) is to be promoted. Thus, it is anticipated that customized training programmes needs to be conducted for the staff at all levels.

71. Well-equipped devices will be required to make these awareness campaigns/training programme successful. Firstly, sufficient place/venue for conducting these programmes needs to be finalized. Well-trained trainers will be required to deliver these training programmes. A group of experienced trainers who have similar kind of experience in conducting the awareness campaigns/training programmes should provide training to the target group, on municipal solid waste management practices. During the training programmes, participants would be given questionnaires for collecting feedback from the participants. This will help to review the success of the programme.

72. The skill up-gradation programmes may be conceptualized and implemented to get the following results:

- Determine roles and responsibilities of each official in specific terms.
- Establish better coordination amongst the staff and departments to carry out different functions related to MSW management in Aizawl town.
- Enhance the knowledge base on problems and issues concerning to solid waste management for each area and pockets.
- Lead to develop effective O&M of facilities such as tri-cycles, Dustbins and Waste containers with the help of public
- Develop an effective monitoring mechanism with the proper involvement of officials responsible.

73. Specific activities in regard to training/Capacity Building Programmes

- Training Need Assessment
- Training Modules for specific Target Groups
- Conducting orientation programme and need based site visits
- Evaluation of Training and orientation programme
- Gap Analysis
- Reinforcement programme to fulfil the GAP
- Setting of appropriate Institutional framework for sustainability

74. Some Proposed tools/methods

- In-house/ interactive sessions
- Exposure visits
- On Task Orientation
- Other innovative programmes

Table 5: Awareness and Capacity Buildings Schedule

S.No.	Activities	Implementation Period
A	Program Communication	
1	Public Address (Focus group meetings, corner meetings, stakeholders meeting workshops and seminars)	Three meetings at different locations in each ward
2	School Programmes (Essay, painting, poster, debates, quiz competitions/ Introduce projects, games and role play & Rallies through students)	3 activities in a month & 30 activities in a year
3	Print Media (Newspapers, Magazines, Flyers etc.) for 10 months	
	Newspaper Articles	1 Media support meeting every month for proper coverage in Newspapers i.e. 10 in a year
4	Electronic media (Cable TV/ Local TV channel)	Continuous Strips for at least 7 months in 2 local channels
5	Support Materials: (Pamphlets, Handouts, Posters, Banners, Wall Paintings etc.)	Displayed continuously for 8 months while covering all wards
6	Street Plays : (Nukkad Nataks)	Street Plays in each middle and lower strata of societies about 23 numbers
B	Training and Capacity Building	
1	Training need assessment study & accordingly preparation of the Training modules	
	Stakeholders' Training Programme	Almost Two every month i.e. 20 in 1 year in AMC
2	Waste Collector	
	a) Sweepers, Tractor Drivers and Landfill Supervisors	10 per year
	c) Private Waste Collectors and Rag Pickers/ Waste segregators	On Lump sum basis (Depends on areas/colonies/ societies and RWAs) =30 meetings
3	Administration and Monitoring	
	a) Administrators and Supervisors	8 per year

75. Details of the subproject components are provided in Table 6. The descriptions shown in the table are based on the present proposals, which are expected to be substantially correct, although certain details may change as development of the subproject progresses.

76. Sectional detail of proposed land fill site with linear system shown in fig 5, details proposed waste resource centre at Tuirialshown in fig 6 and layout for proposed compost & vermi – compost plant shown in fig 7 & 8. Map showing AMC boundary of Aizawl Marked in pink line and location AMC ward in blue in fig 9 Google image of landfill site is shown in Figure 1o. Location of proposed landfill site on toposheet is as Figure 11. Google image of the project location and existing solid waste dump site is shown in Figure 12 & 13 respectively. Location of existing solid waste dump site with pilot resource centre and under construction of incinerator unit for bio – medical waste in Google image is represented Figure 14. Location Plan of Proposed Landfill site is shown in Figure 15. The topographic map showing the proposed landfill site in Tuirial is presented in Figure 16. The map showing the existing dumpsite in Tuirial is presented as Figure 17.

Table 6: Aizawl Solid Waste Resource Management Subproject Components

Component	Location	Function	Description	Remarks
(i) Improvement in Collection and Transportation System				
Two covered bins for households	to be placed in household for pilot project in the city	Waste collection, Waste Segregation	66094 units	no physical interaction with the environment
wheelbarrows	Various locations	to be used by street sweepers	148 units	no physical interaction with the environment
3. gloves	Various locations	To be used by safai karamcharis	420 units	no physical interaction with the environment
4. Boots	Various locations	To be used by safai karamcharis	456 units	no physical interaction with the environment
5. Shovels	Various locations	to be used by street sweepers	354 units	no physical interaction with the environment
6. Broom	Various locations	to be used by street sweepers	354 units	no physical interaction with the environment
7. Dust pan	Various locations	For door to door collection	55 units	no physical interaction with the environment
8. Uniform	Various locations	To be used by safai karamcharis	456 units	no physical interaction with the environment
9.Safety Mask	Various locations	to be used by street sweepers	384 units	no physical interaction with the environment
10. light vehicle with bell ringing system	Various locations	For collecting the wastes from house-to-house (to be used in areas where access for medium truck is not possible).	50 units	no physical interaction with the environment
11. medium duty tipper trucks	Various locations	For collecting the waste from house-to-house	4 units	no physical interaction with the environment

Component	Location	Function	Description	Remarks
		with introduction of bell ringing system (to be used in households along main roads).		
(ii) Compost and vermi-composting plant	Tuirial	For biodegradable waste from the segregation process	Will be designed to accommodate 38% of the generated waste.	Number trees will be cut. Permission from the Mizoram Forest Department has already been obtained (APPENDIX –3). Renewal of Consent to establish composting plant & engineering Landfill site has been obtained (APPENDIX –4). Application for Consent to establish Vermi- composting plant is applied and consent is awaited from MPCB (APPENDIX –5). Surplus soil will be used for levelling and backfilling.
(iii) Construction of waste resource management center	New Landfill site	To separate the segregated non-biodegradable waste for recycling.	Will be designed for segregating the recyclable waste of 64% of the total waste collected.	Number trees will be cut. Permission from the Mizoram Forest Department has been obtained as it will be within the proposed landfill site. (APPENDIX –3). The spoils will be used for filling works etc.
(iv) Construction of a new engineered landfill and associated infrastructures				
landfill equipment	New landfill site	For use in the landfill operations at Tuirial.	Water tanker, front end loader with back hoe, tipper truck, vibro compactor, 90 Hp tractor with dozer, safety equipments, firefighting equipment, weighbridge	no physical interaction with the environment
new engineered landfill	new landfill site at Tuirial	Final disposal site for residual wastes	Will be designed to accommodate 8% of the generated non-biodegradable	Number trees will be cut. Permission from the Mizoram Forest Department has been

Component	Location	Function	Description	Remarks
			waste. 10 hectares area with drainage, leachate collection system and treatment facilities. 33% of the 15 hectares will be allocated for greenbelt	obtained as it will be within the proposed landfill site. (APPENDIX –3). Environmental Clearance has already been obtained from MoEF. (APPENDIX –1). Excavation will be carried out using bulldozers. Surplus soil will be used for balancing.
Leachate Management	new landfill site at Tuirial	For Leachate collection and removal	Leachate is generated due to exposure of uncovered waste to the precipitation and will be collected and treated to prevent contamination of groundwater. The main components of the leachate collection systems are feeder main and leachate collection sump. A minimum size of 110 mm high density polyethylene (HDPE) pipes is recommended for feeder pipe. Similarly header pipes are designed to take the flow from feeder pipe and a minimum size of 160 mm is recommended with spacing at 25 mm. A main pipe of 450 mm dia connected inside with submersible pump to pump leachate. A 200 mm thick graded pebble and 100 mm thick sand layer is provisioned as drainage layer to facilitate the removal of leachate.	
Associated facilities	new landfill site at Tuirial	For landfill operation	Approach road and internal roads	Approach roads, internal roads and temporary roads are all

Component	Location	Function	Description	Remarks
			Compound wall and boundary fencing Main entrance gate Weigh bridge Administrative office building/weighbridge operator's room Common toilets and septic tanks Security guard's room Bore well with steel casing Vehicle washing area and vehicle parking area are also earmarked. Electrical works for street lighting and internal lighting. Godown/ sales emporium	within existing right of ways. Excavation will be carried out using bulldozers. Surplus soil will be used for balancing.
(v) Capping of existing dumping site	Dumping site at Tuirial		Guidelines for capping, Ministry of Environment and Forest (MoEF), 1991 will be followed.	Appropriate Liners will be provided along with storm water drains.

Figure 6: Details of Proposed Land Fill Section with Linear System

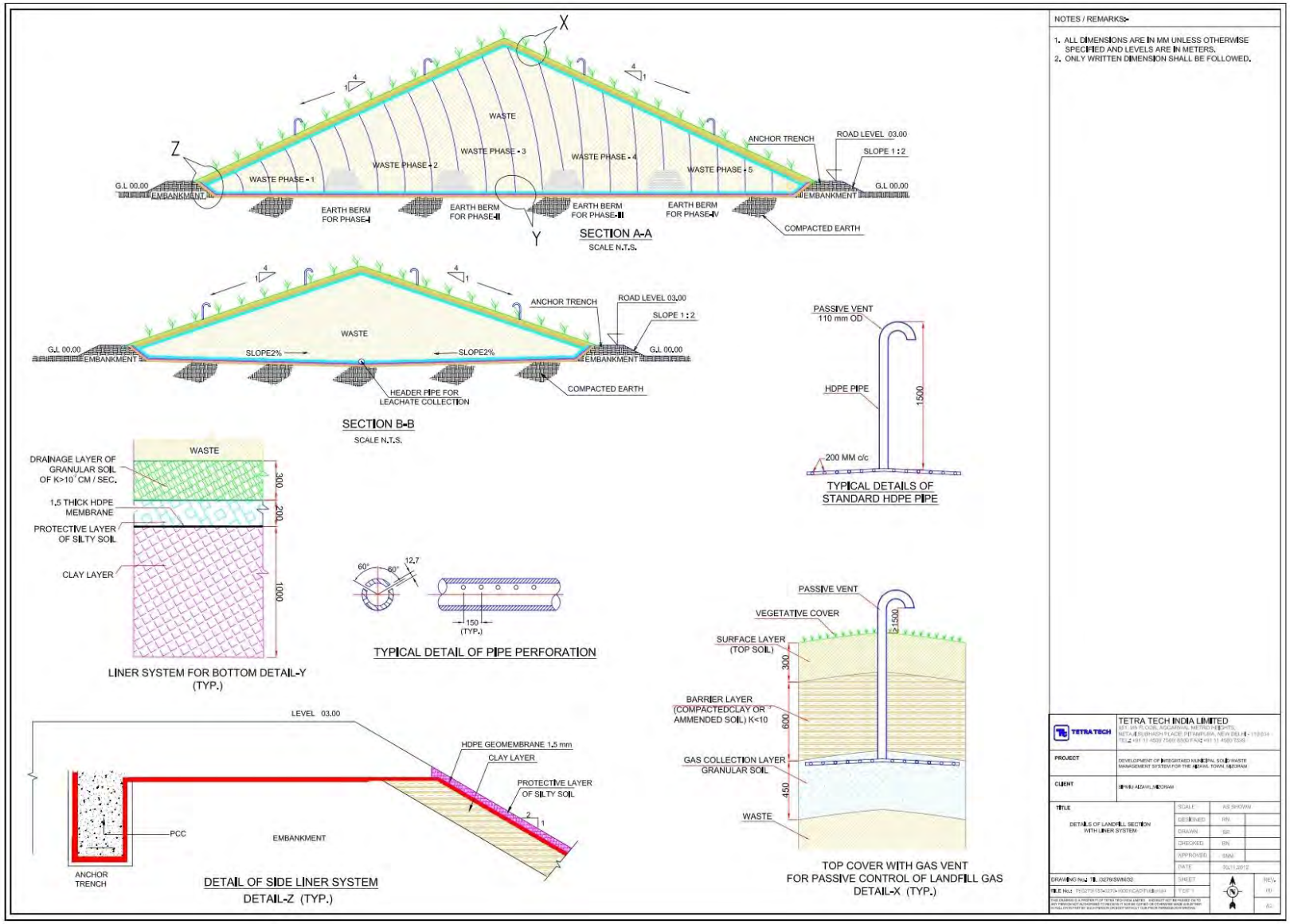


Figure 7: Details of Proposed Waste Resource Centre at Turil

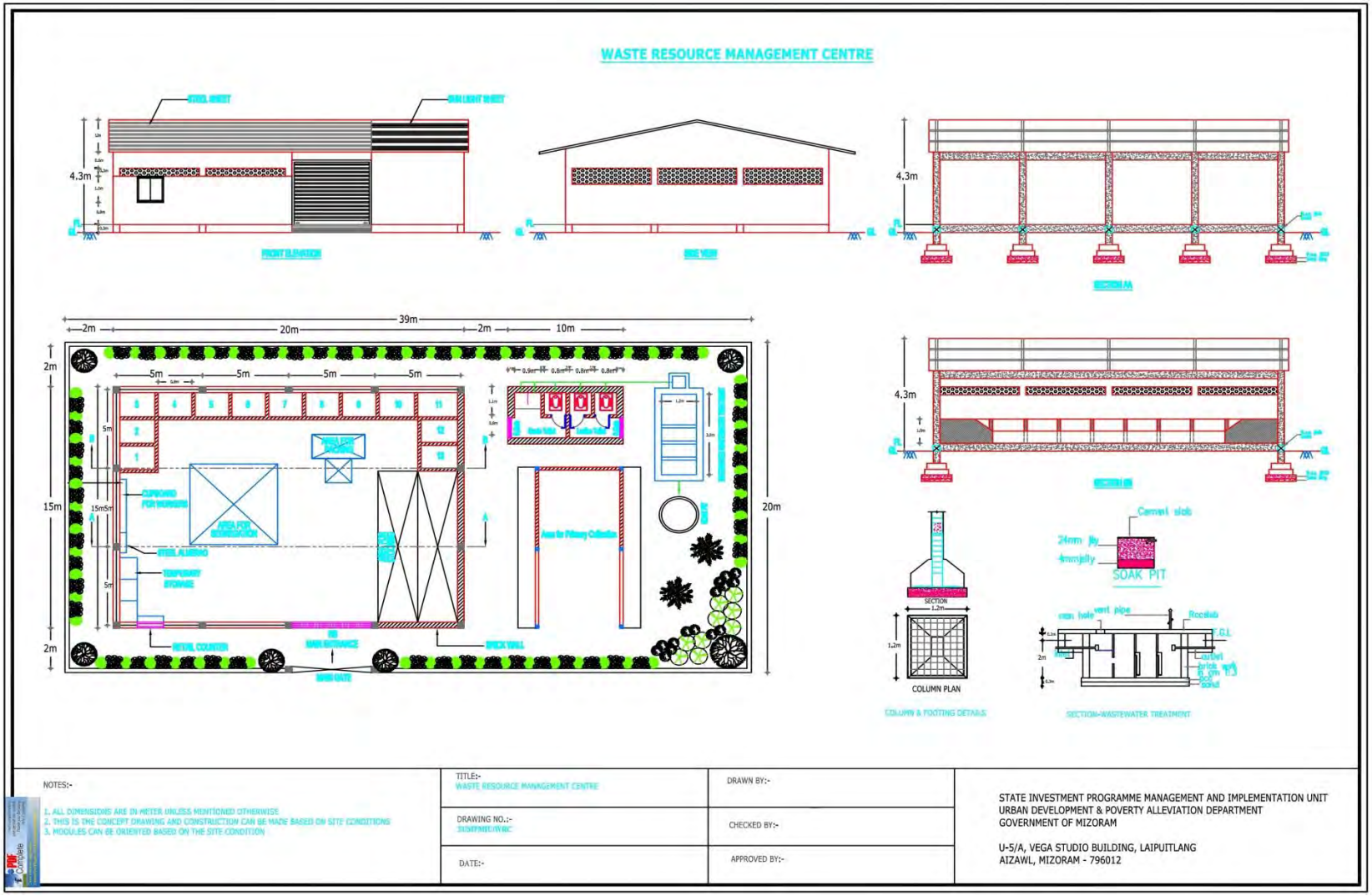


Figure 8: Layout of Proposed 50 TPD Compost Plant at Turil

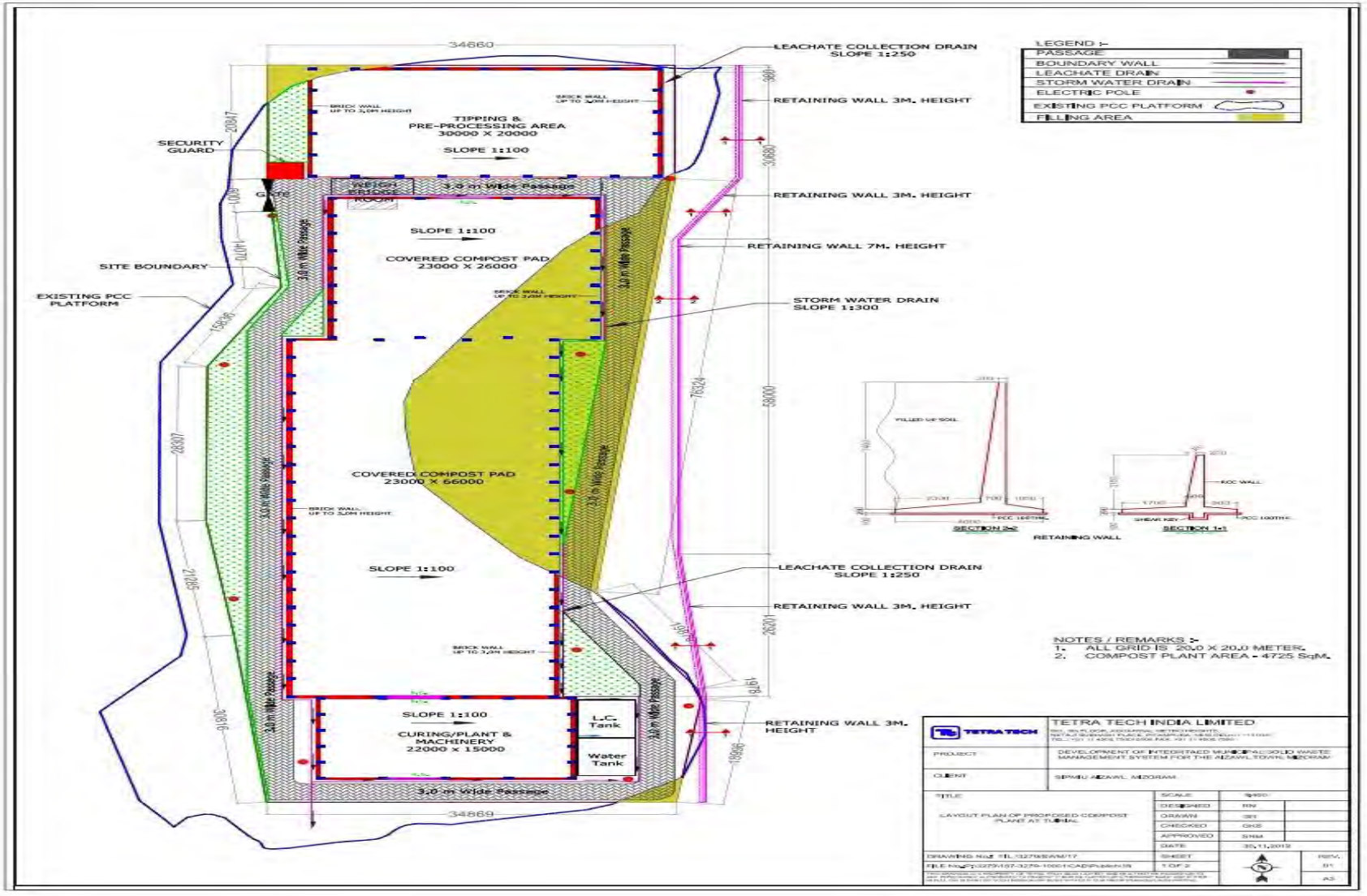
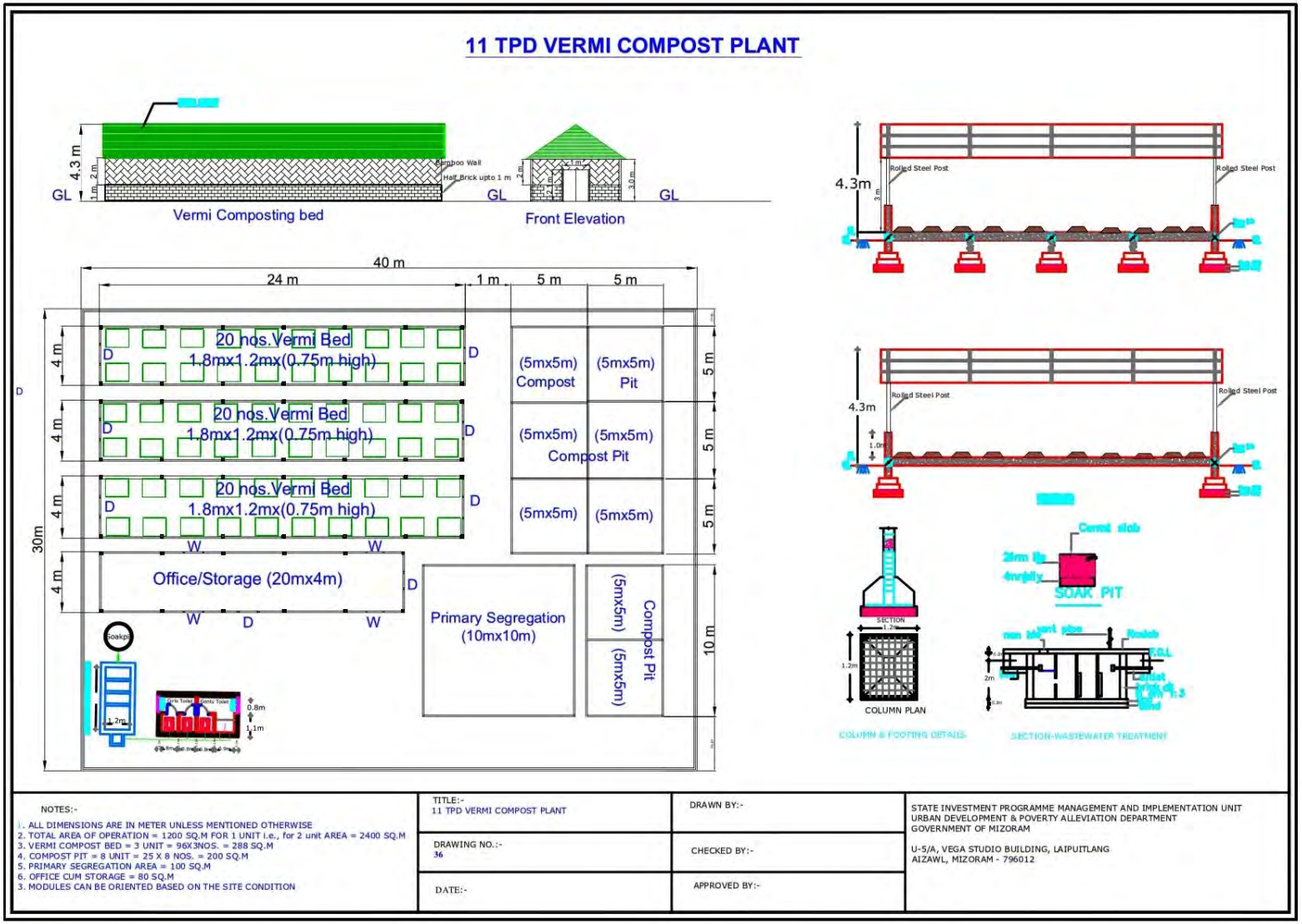
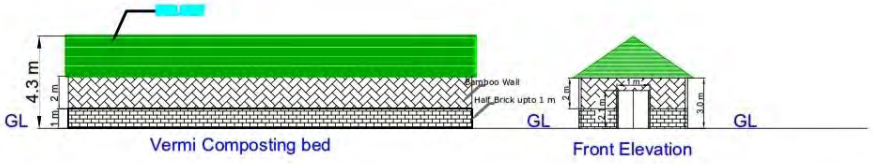
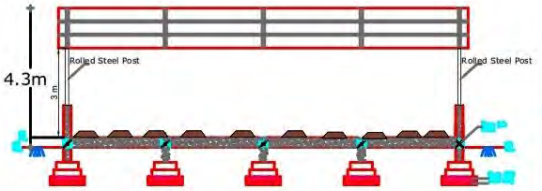


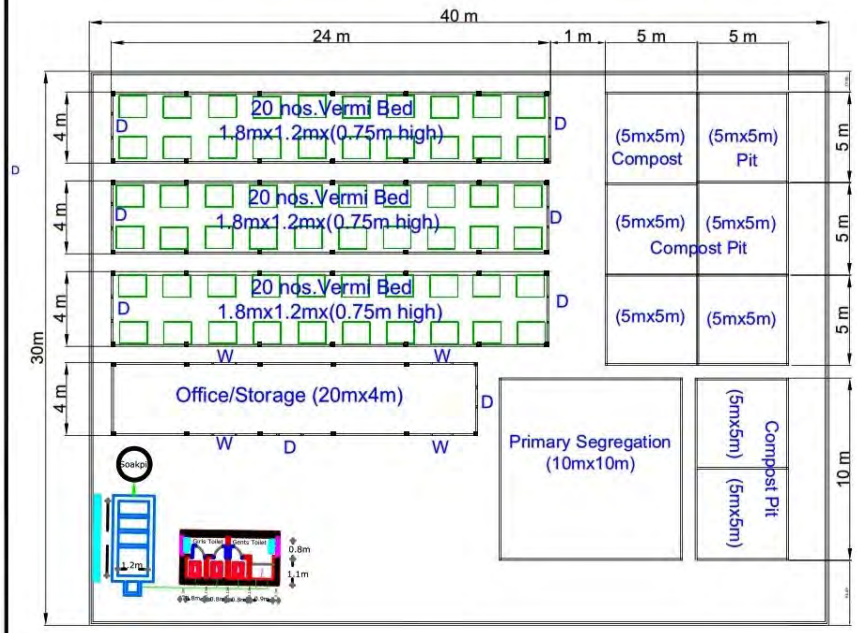
Figure 9: Layout of Proposed 11 TPD Vermicompost Plant

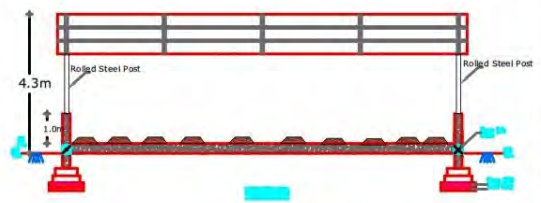


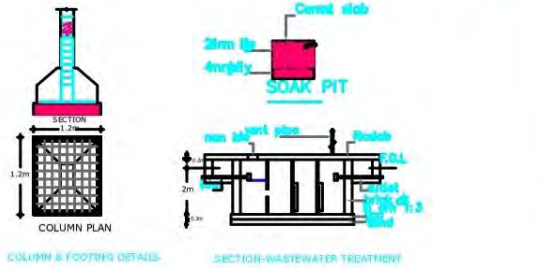
11 TPD VERMI COMPOST PLANT











NOTES:-

1. ALL DIMENSIONS ARE IN METER UNLESS MENTIONED OTHERWISE
2. TOTAL AREA OF OPERATION = 1200 SQ.M FOR 1 UNIT i.e., for 2 unit AREA = 2400 SQ.M
3. VERMI COMPOST BED = 3 UNIT = 96X3NOS. = 288 SQ.M
4. COMPOST PIT = 8 UNIT = 25 X 8 NOS. = 200 SQ.M
5. PRIMARY SEGREGATION AREA = 100 SQ.M
6. OFFICE CUM STORAGE = 80 SQ.M
3. MODULES CAN BE ORIENTED BASED ON THE SITE CONDITION

TITLE:- 11 TPD VERMI COMPOST PLANT	DRAWN BY:-	STATE INVESTMENT PROGRAMME MANAGEMENT AND IMPLEMENTATION UNIT URBAN DEVELOPMENT & POVERTY ALLEVIATION DEPARTMENT GOVERNMENT OF MIZORAM
DRAWING NO.:- 36	CHECKED BY:-	U-5/A, VEGA STUDIO BUILDING, LAIPUITLANG AIZAWL, MIZORAM - 796012
DATE:-	APPROVED BY:-	

Figure 10: Map showing AMC boundary of Aizawl Marked in pink line and location AMC ward in blue

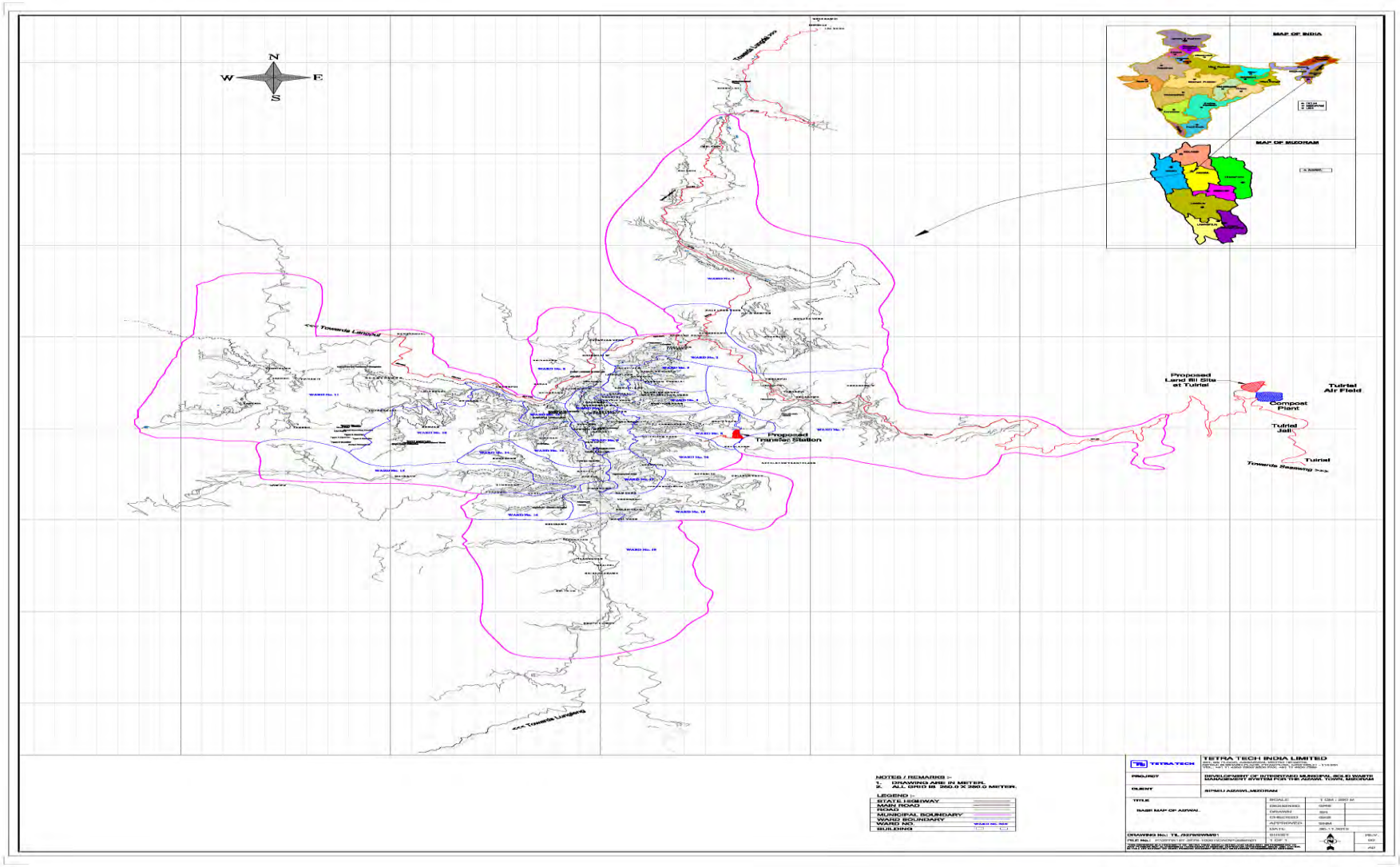


Figure 11: Google Imaginary of Land Fill Site

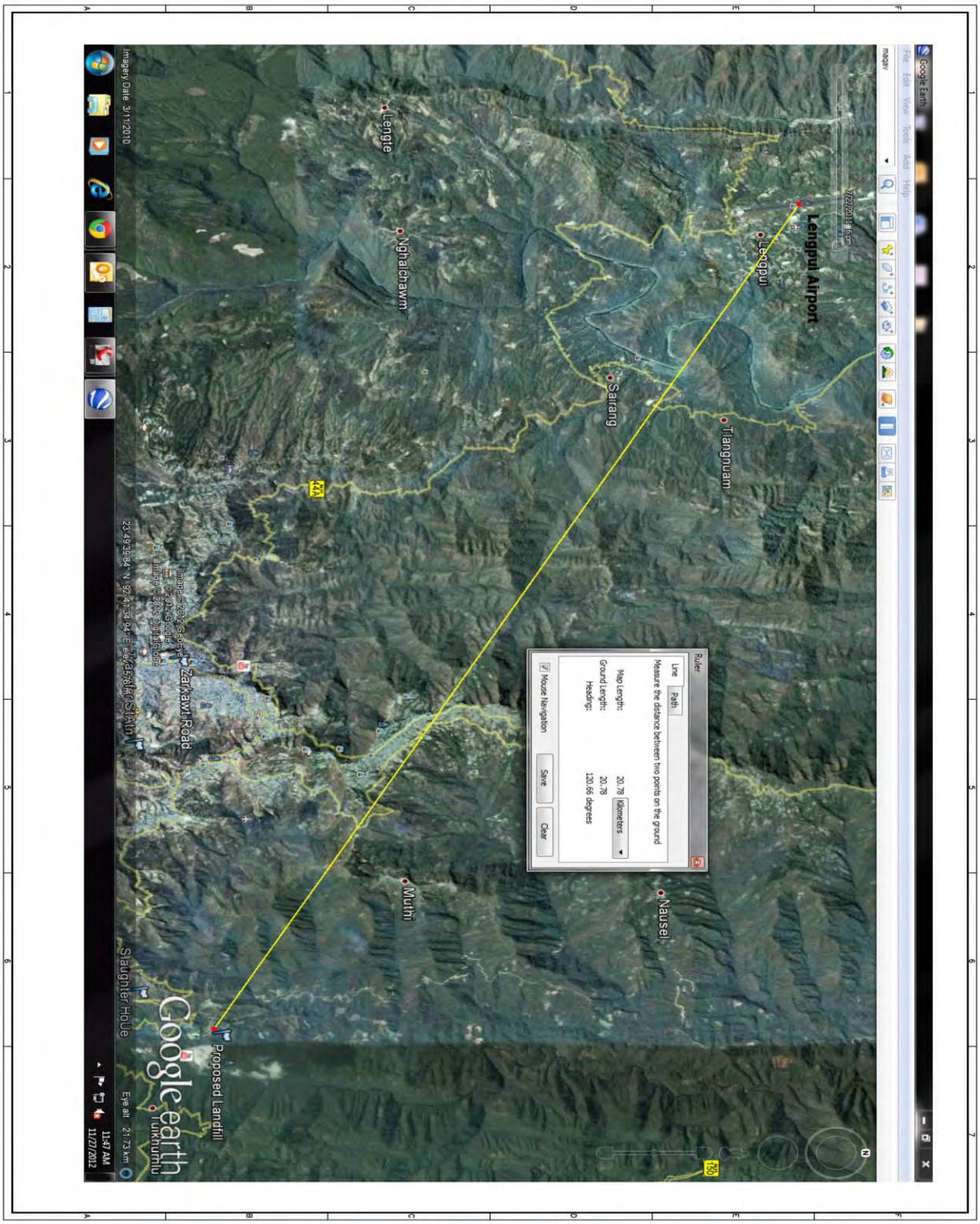


Figure 12: Location of proposed landfill site on toposheet

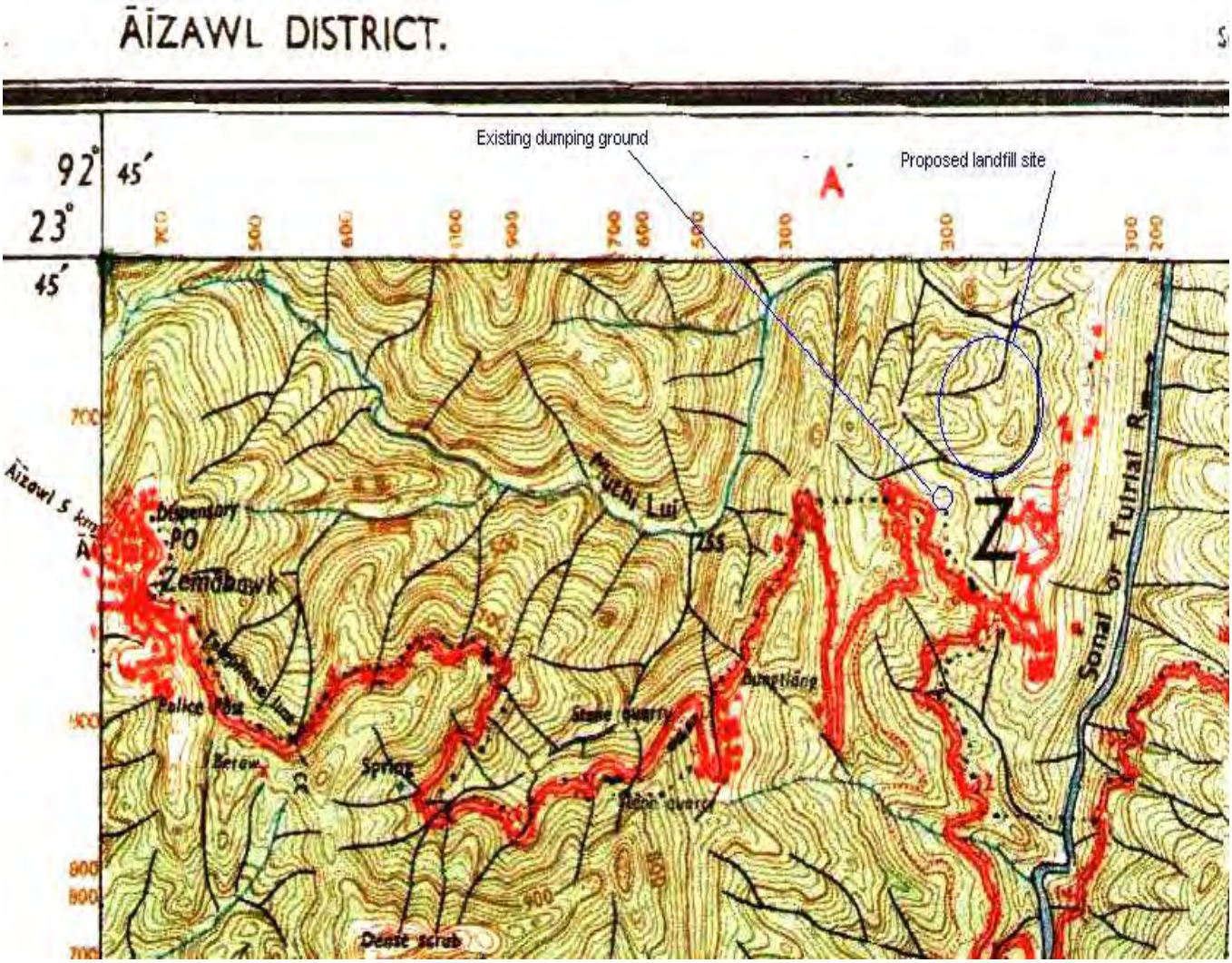


Figure 13: Google Image of the Project Location

Figure 14: Google Image of Existing Solid Waste Dump Site

Figure 15: Google Image of Existing Solid Waste Dump Site with Pilot Resource Centre & under construction Incineration Unit for Bio – Medical Waste

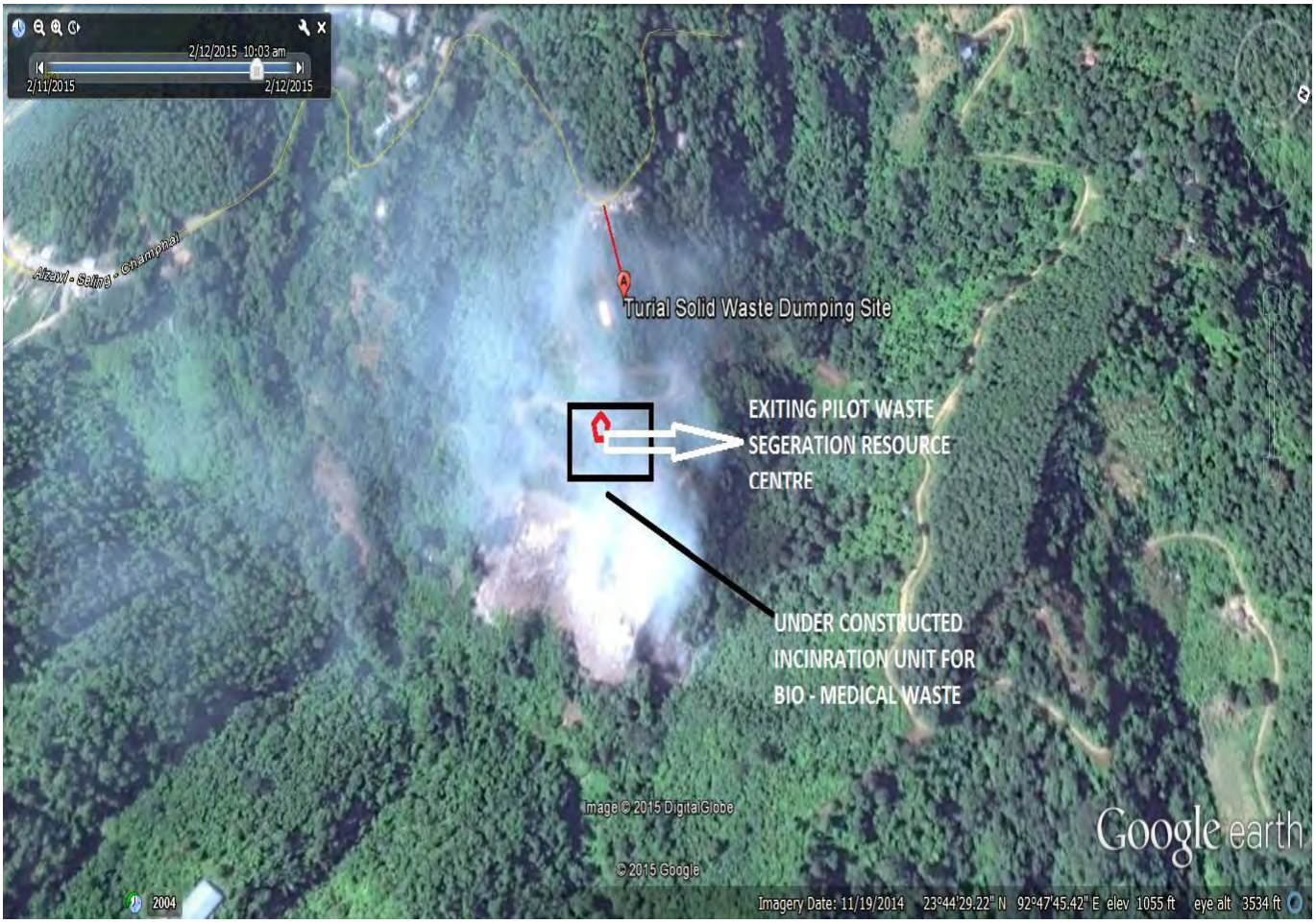


Figure 16: Location Plan of Proposed Landfill Site

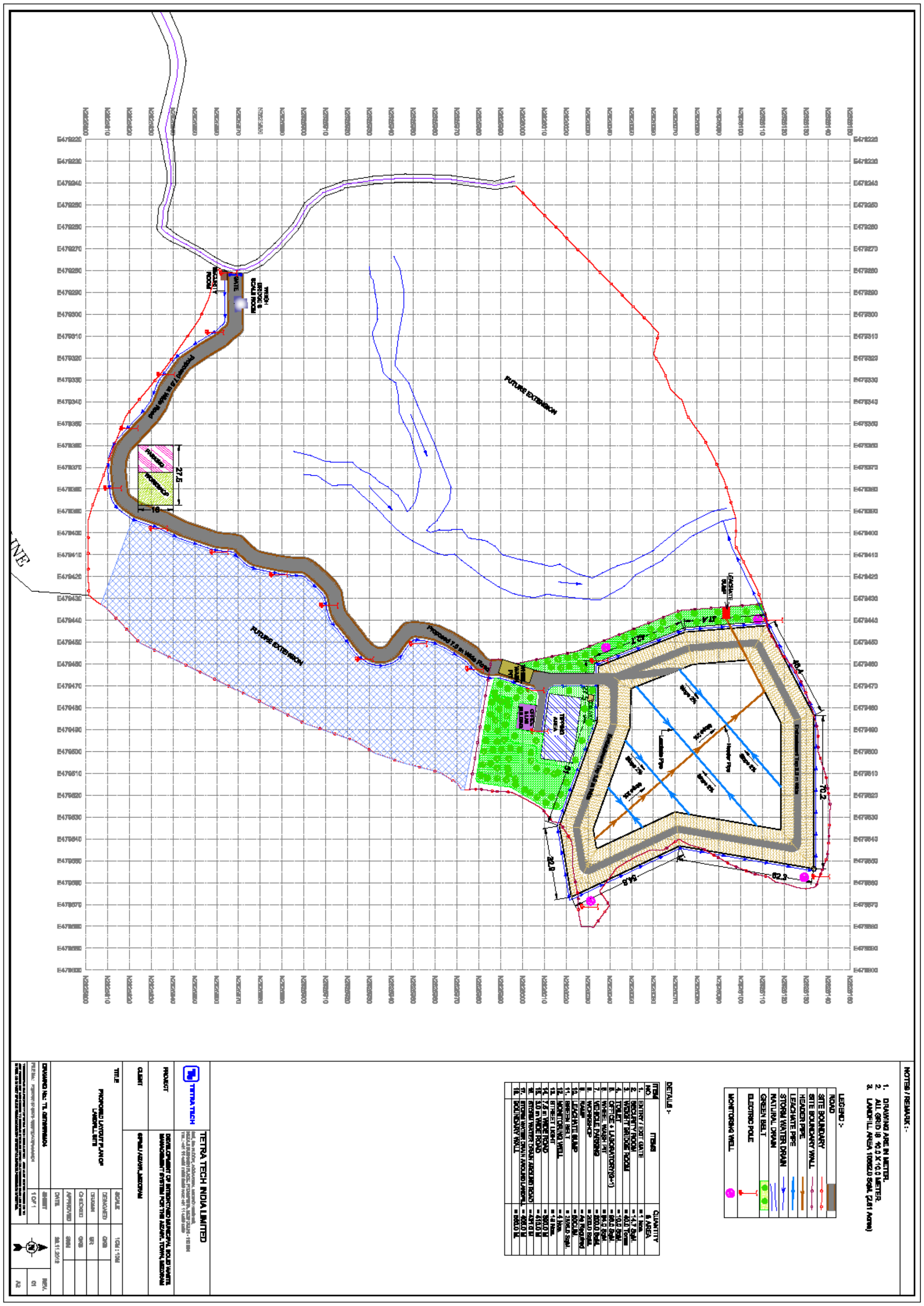


Figure 17: Topographic Map Showing the Proposed Landfill Site in Tuirial

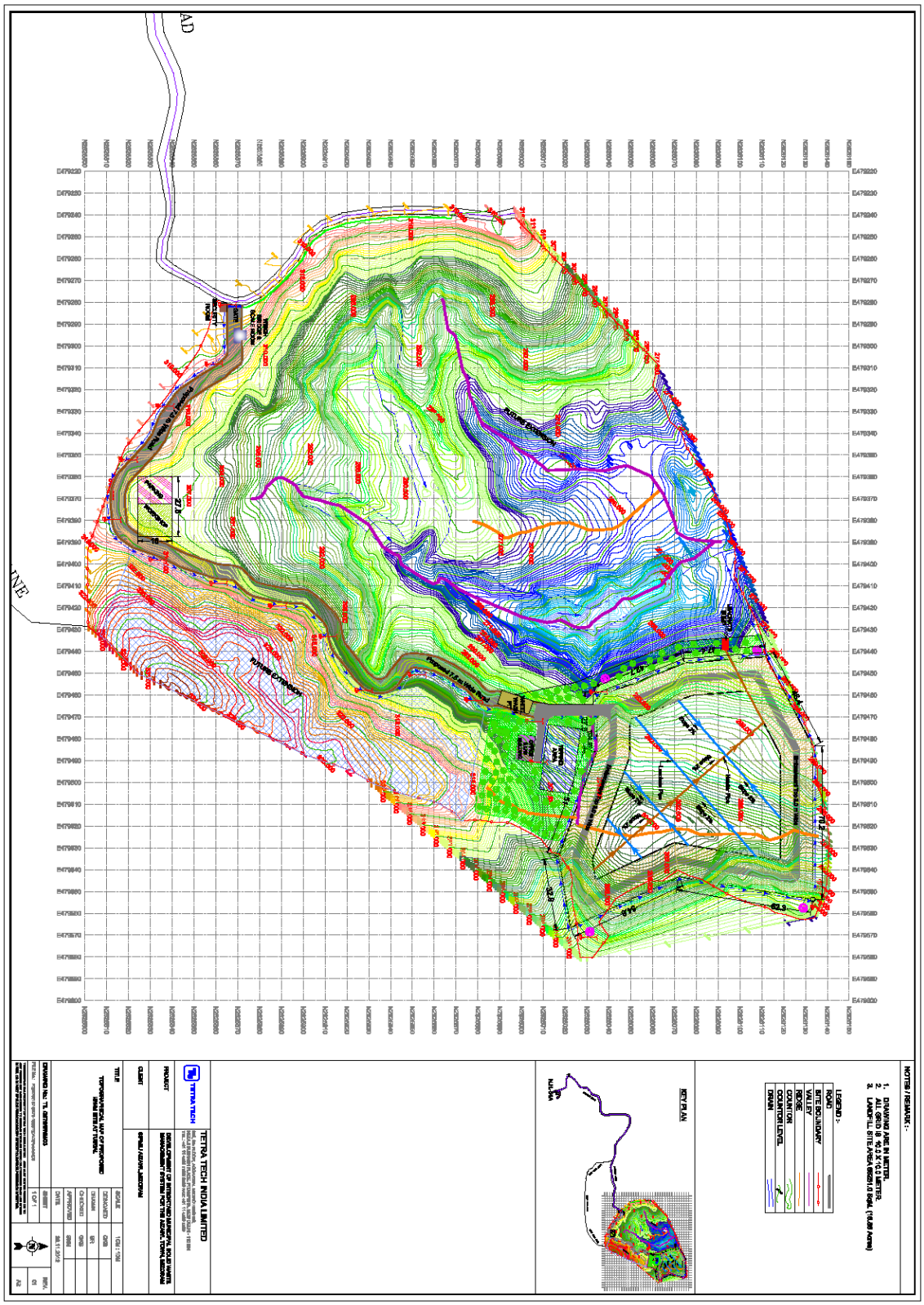
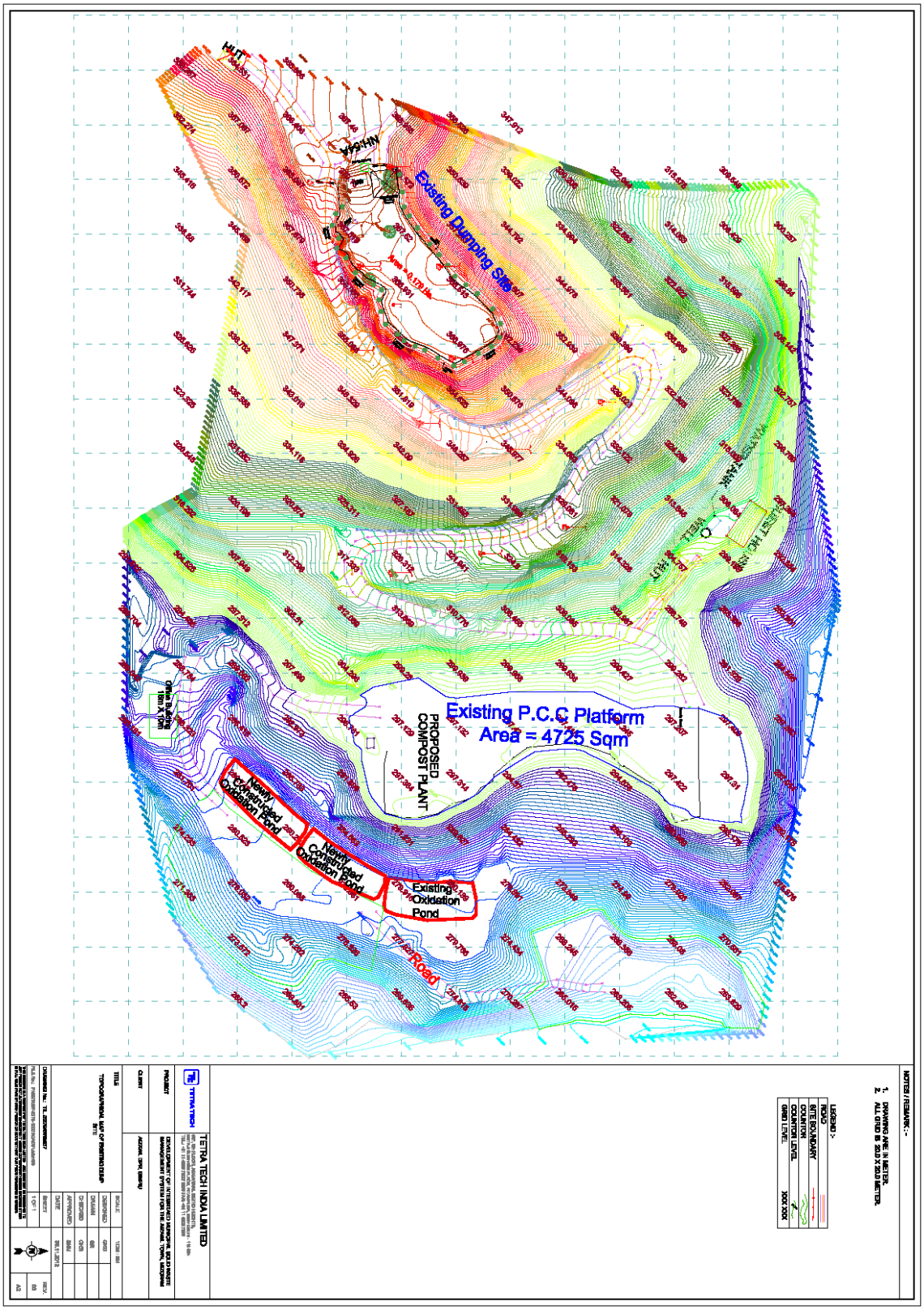


Figure 18: Map Showing Existing Dumpsite in Tuirial



III. DESCRIPTION OF THE ENVIRONMENT

A. Physical Resources

1. Location and Administrative Boundaries

77. Aizawl, the capital of Mizoram lies between 92°30¢- 92°60¢ E - longitude and 21°58¢-24°85¢ N latitude. The city of Aizawl is located on one prominent north-south extending ridgeline, situated between 700 m to nearly 1288 m from the Mean Sea Level. Aizawl is linked with rest of India through the National Highway 54 (NH 54). The nearest air linkage is at Lengpui, 32 km from the city.

78. **Location – Landfill Site**: The proposed landfill site covers an area of about 15 hectares. It is located near Tuirial and is 20 km distance from Aizawl city. The closest habitation is 4 km from the boundaries of the site.

2. Topography, Drainage, and Natural Hazards

79. **Topography**: Mizoram is a land of rolling hills, rivers and lakes with mainly clayey loam soil mixed with broke angular shale of varying size. The Mizo Hills, which dominate the state's topography, rise to more than 6560 ft near the Myanmar border. There are as many as 21 major hills ranges or peaks of different heights run through the length and breadth of the state with the highest peak 'Phawngpui (Blue Mountain) towering 2,065 metres above the sea level. The terrain has, perhaps, the most variegated topography among all hilly areas in this part of the country. The hills are extremely rugged and leaving some plains scattered occasionally here and there. The region, in general, exhibits first - order topography of folded Miocene Strata. The compact and relatively - older rocks constitute these ridges and the younger strata make up the valleys. Elements of second - order topography are seen towards east of longitude 93°30’ East.

80. **Topography – Landfill Site:** Aizawl is situated in hilly environment hence availability of flat area is very rare. The site is situated in hilly terrain in a valley with elevation ranging from 260 to 368 m. As Aizawl Town is situated in a hilly environment, a very few relatively flat areas owned by the government exist for development of a solid waste landfill facility. The proposed site, although situated in hilly terrain maintains adequate area of wider contours, and requiring relatively little grading work. With proper engineering the site is deemed sufficient for its landfill purpose and a much needed improvement over the existing unsanitary dumping conditions the town currently maintains.

81. **Drainage:** Being situated on a hilly terrain with more than 20 % slopes, most of the rainwater flows down as surface run off. The natural drainage system of the city includes: (i) eastern drainage system; and (ii) western drainage system. Two rivers surround the city along its sides, namely Tuirial River on the eastern side and Tlawng River on the western side. The storm water and the wastewater from the Aizawl city ultimately get drained out into these two river systems. The eastern portion of the city is drained mainly by Chite-lui (covers more than two third of the eastern portion) and Tuirial rivers. The river Tlawng, flowing from South to North, carries water from the western part of the city.

82. **Drainage – Landfill Site:** The natural drains of the site are towards Tuirial River. None of these drains are used as drinking water source as a result there is little concern for water quality in so far as drinking is concerned. This river receives water from surrounding hill areas.

83. **Natural Hazards:** The Capital City Aizawl falls under Seismic Zone -V. It is referred to as the Very High Damage Risk Zone. The Indian states Kashmir, Punjab, the western and central Himalayas, the North-East Indian region and the Rann of Kutch fall in this zone. Generally, the areas having trap or basaltic rock are prone to earthquakes. The present valleys and ravines are the result of the underlying faults and structural patterns, giving origin to different types of drainage patterns. Faulting has resulted in creation of steep curves, highly dissected ranges with deep ravines, spurs etc. vulnerable to comprehensive erosion. The rocks are fractured and hence susceptible to failure during monsoon resulting in landslides.

84. Subsidence is another problem encountered in the Aizawl. Land subsidence and soil fissuring are though generally considered as phenomena connected to groundwater extraction or consolidation of strata in sedimentary basins, the subsidence case of Aizawl appears to be a result of fluvial action. This is particularly because all the subsidence cases occur during and just after the rainfall. The percolated water which comes out as return flow also carries the finer fraction of soil, which adversely affects the shear strength parameter. Removal of finer fraction can also lead to formation of piping in the subsurface and result in sudden subsidence. Presence of dissolved material in the subsurface can also lead to subsidence if the area remains under action of water for a relatively long period.

85. **Geology:** Mizoram constitutes the sedimentary basin complex of Assam Shelf and Assam-Arakan. The Assam-Arakan sedimentary basin is a shelf-slope-basinal system. The shelf part of the basin spreads over the Brahmaputra valley. The basinal part (geosynclinals) is occupied by the Naga Schuppen belt and the Cachar, Tripura, Mizoram and Manipur fold belts. The Assam-Arakan fold belt extends southward to the Cachar-Mizo fold zone. West of this zone, lies the frontal belt of Tripura with mostly closed folds which gradually become tighter towards east in Mizoram. The common rocks found are sandstone, limestone, shale, silt stone and slates. The rock system is weak and unstable, prone to frequent seismic influence. The geo-morphological formations consist of steep hill slopes and deep valleys oriented on the topographic surface in a linear fashion.

86. **Soils:** The soil formation of Aizawl, in general, is of loose sedimentary type, with high porosity and permeability. This results in the city being highly susceptible to erosion and rain induced landslides, leading to severe damages to property and lives every year. Soils vary from sandy loam and clayey loam to clay, generally mature but leached owing to steep gradient and heavy rainfall. The soils are porous with poor water holding capacity, deficient in potash, phosphorous, nitrogen and even humus due to the traditional practice of shifting cultivation called ‘jhuming’. The pH shows acidic to neutral reaction due to excessive leaching (Environment & Forest Department Report 2003). Shifting cultivation principally practiced in Mizoram affects soil productivity through increase of soil acidity, lowering of surface moisture and intensifying erosion losses of soil and nutrients through runoff.

87. **Climate:** The climate of Mizoram is neither very hot nor very cold, but moderate throughout the year. The whole state falls under the direct influence of south-west monsoon and receives an adequate amount of rainfall. The fluctuation in temperature is not much and the highest temperature is observed during May to July and starts decreasing with the onset of monsoon. This fall of temperature continues with the span of monsoon and becomes more evident with the retreating monsoon. The temperature becomes minimum in December and January. In summer the temperature ranges between 18°C to 32°C. During winter season, the minimum and maximum temperature ranges between 8°C to 32°C. During the last two decades, a substantial increase in average temperature has been observed, which may be due to global warming. Relative humidity in the dry season is 60–70% and in the monsoon period is about

90%. During southwest monsoon, February to April is comparatively dry when humidity is between 60–70%.

88. **Air Quality:** There are no major air-polluting industries in Aizawl and traffic/vehicular emission is the only significant source of pollutant, so air quality is likely to be well within the National Ambient Air Quality Standards (NAAQS).

89. **Air Quality – Landfill Site:** As there are no major air pollution potential sources and vegetation present in the proposed site, the air quality is generally good. However, due to the unscientific waste disposal in the existing dumpsite (near the proposed landfill site), foul smell and thick smoke coming from burning of wastes are deteriorating the air quality of the disposal site.

90. **Noise Level:** The observed noise levels in the project area of Aizawl were measured over 24 hrs using a handheld noise meter. The results indicate that noise levels are higher than the threshold limits.

91. **Noise Level – Landfill Site:** The subproject site is in a undeveloped area without any industry or commercial activity and hence the noise level is within the standards.

92. **Surface Water:** The analysis of water quality of rivers within Greater Aizawl, namely the Chite Lui and Lawibual rivers indicate that the water quality parameters are within the prescribed standard values. Low values of Turbidity, Total Dissolved Solids, non-existence of Oil & Grease and high value of Dissolved Oxygen clearly indicate that the water quality of the rivers is fairly good. However, Coliform is present in higher concentrations.

93. **Surface Water – Landfill Site:** There are 2 small seasonal drains within the proposed landfill site for carrying surface run off (but catchment area is small). All these seasonal drains meet at a point downstream to the Tuirial River. Water quality of the river is generally good since there are no pollution sources upstream.

94. **Groundwater:** Due to the hilly terrain with slopes more than 20%, most of the rainwater flows out as surface run off. Hence, the scope of groundwater storage is limited and is depending upon the secondary porosity and structural control in the higher elevated aquifers. The groundwater stored in these aquifers emanates in the form of springs that act as a source of water supply for the people especially in the rural areas. The ground water exploration done by the Central Ground Water Board (CGWB) indicates that there is considerable potential for exploration of ground water within a depth range of 200 m with a potential yield ranging from 120 to 330 litres per minute for draw down of 13 to 20 m. While the quality of ground water is found to be potable from the hydro-chemical point of view, the hydro-geological conditions in Aizawl are not favorable for ground water recharge and storage.3

95. **Groundwater – Landfill Site:** Ground water level is more than 20 meter and it is expected to be good quality due to absence of any pollution sources and depth of the groundwater table.

[3] Report on Dynamic ground water resources of Mizoram, March 2004. Central Ground Water Board, NE Region, Guwahati.

B. Ecological Resources

96. Though there are sizeable areas covered by large varieties of vegetation and small grasses, within Aizawl, there are no major tracts of designated reserved forests within the subproject boundaries.

97. The forest type of Aizawl is represented by Tropical semi-evergreen forest. A phyto diversity survey was carried out at some of the project locations in Greater Aizawl Planning Area (GAPA) using the Shannon-Wiener Diversity Index, and evenness with the Evenness index. The indices were employed to get a comprehensive, easily comparable, and quantitative estimate of the diversity and degree of evenness (i.e., uniformity) of the plant community. The indices show that there are no priority sites within GAPA. Dampa Sanctuary (Protected Area) is situated near the Bangladesh Boundary and is very far from the GAPA.

98. **Ecological Resources – Landfill Site:** Vegetation exists adjacent of the subproject site but no major trees have been observed within and around the site. There is no critical habitat in the vicinity of the proposed site.

C. Economic Development

99. **Land Use:** The Aizawl development planning area covers an area of 128.98 sq km of which 21.58% of the total area is developed whereas 78.42% of the total area is not suitable for developing due to excessive slopes and instability due to landslides. 1.98% of the total area is under cantonment / defense area.

100. **Land Use – Landfill Site:** Efforts shall be made by AMC to comply with the requirement of the CPHEEO Manual. The Manual recommends that a zone of 500 m around the landfill boundary should be declared a “No-Development Buffer Zone” after the landfill location is finalized.

101. Local Economy – Commerce, Industry and Agriculture: In recent years Aizawl has seen growth in its industrial sector and is becoming one of the most important industrial centers of Mizoram. Out of the total registered industrial units of the entire state of Mizoram as many as 1,134 or 51.43% are concentrated in Aizawl city. Industrial growth and development in Aizawl is mainly in seen in small scale sectors.

102. Since 1972, mining and quarrying for building materials has been started within Aizawl city. As per the information from the Geology and Mining Wing there are more than 29 quarries without any legal support. The method of extraction is mainly through drilling, blasting, etc. which is leading to slope instability. The unused materials are disposed off alongside the quarries and slopes causing environmental problems.

1. Infrastructure:

103. **Water Supply:** Water supply in Aizawl is in a state of crisis. Most people are dependent upon the piped water supply system, which presently provides water for only an hour or so a week. People have installed rainwater catchment and storage systems and sometimes are able to get water from springs or the ground. However, average consumption during the rainy season is not more than 80 liters per capita per day (LPCD) and it is much less, perhaps as little as 50 or 60 LPCD, during the dry season. The River Tlawng is the major source of water for Aizawl. Water supply from this source involves a high static lift of 1017 meters, from the riverbed level at

146 meters to the main storage reservoir at 1163 meters, making it one of the most expensive water supply systems in India. However, after completion of tranche – 2 water supply systems in the city will be more adequate.

104. **Sewerage and Sanitation:** At present, the city possesses no sewerage system. All the house sullage (kitchen and bath room waste water) drains into nearby streams along the hill slopes, whereas human excreta from households are disposed off either in septic tank / soak pit or directly discharge into the natural drains. However, the construction of 10 MLD Sewerage treatment plant at Chite and the sewerage network in densely populated areas will improve the existing system. The work is being carried out under tranche – 2 which is ongoing.

105. **Roads and Transportation.** The road network is characterized by the presence of NH 54 running from east to west connecting Sairang/Silchar in the West and Lunglei in the East. One major district road is running from north to south and other roads branching out from this main road. Due to topographical constraints, almost all roads are narrow and the intersections and junctions in the city are 'V' shaped. At most of the intersections, there is absence/poor-turning area. The road sections that have poor geometric alignment and steep gradient include (i) Armed Veng to Bawngkawn, (ii) Republic Kawipui to Treasury Square, (iii) Salem Veng to Damveng, (iv) Secretariat complex to Tuikhuatlang, (v) D. Hnunliana to Industry Mualpeng, (vi) Mission Vengthlang to Synod Book-room, and (vii) Bethlehem to Bungkawn in the city of Aizawl.

106. **Drainage:** Though Aizawl has numerous drains criss-crossing the city, the drainage situation has come to a deplorable state with choked, over flowing drains, acting as disposal point for solid waste and sewage. The poor drainage conditions coupled with loose sedimentary soils and unregulated construction activities for developmental purposes have lead to a substantial incidence of landslides.

107. **Health Facilities:** The city has 7 major hospitals out of which, two hospitals are run by the Presbyterian and Seventh Day Adventist Church and one is a private hospital. Also, there are about 23 dispensaries and sub-health centers scattered all over the city.

108. **Slum Up gradation:** There are no notified slums in the city. However, several areas especially on the fringes of the city, at lower elevations where wastes are concentrated, have extremely poor living conditions. These areas have poor accessibility and therefore, are also critically short of basic infrastructure. The State Government is in the process of identifying such areas in the city and notifying them as slums. It is of utmost priority that such areas be notified as slums and then phased improvement measures can be taken up.

109. **Education Facilities:** Being the state capital, it has all levels of education facilities such as one university campus along with 11 colleges and considerable number of higher secondary schools, high schools, middle schools and primary schools. The city also has one veterinary college, one polytechnic institute, one industrial training institute and two-law colleges.

D. Social and Cultural Resources

110. **Demography:** The GAPA has a total population of 293,416 as per 2011. Earlier census recorded as per 2001 was 237,787 a total rise of 23.39%. Around 52% of the urban population of the state lives in the city. With respect to literacy rate, Aizawl has attained a literacy rate of 100%, which is more than the national average (64.8%) and state average (88.49%). Within the city, only 15.9% of the populations have education up to graduation and beyond. Workers

engaged in various activities reflect the predominance of tertiary sector, with 48.7% of the population in salaried services.

111. Ninety eight percent of the population in Aizawl belongs to the scheduled tribes. The main indigenous groups are the Lushais, Chakmas, Ralte, Paite, Baite, Pawi Dhilen, Lakher, Hmar and Piang. Lushai group of tribals accounts for more than 98% of the city tribals. Though they speak their tribal dialect among themselves, they also speak English in general, while interacting with others. Most tribes are Christian (84%). Though categorized as tribes, they are into modern means of production and consumption.

112. **History, Culture, and Tourism:** Aizawl is the capital of the state Mizoram. It is a hilly place and is a beautiful site as you look around buildings erected on the steep hill slopes; it is also another wonder for tourists. The beautiful churches usually painted in white colours in every locality are yet another wonder. Chapchar Kut the festival celebrated during the month of March is the most joyful festival of the Mizo's where young and energetic –men and women dressed in their colourful attires all poised to perform the colourful Cheraw dance and other cultural dances and is one of the biggest tourist attraction. There is no heritage building nor is there any property related to cultural activities in the surroundings of the proposed sanitary landfill site.

113. **Indigenous People:** In Aizawl and the entire state of Mizoram, the tribes constitute the mainstream society. Aizawl has predominantly tribal population (95% of the total population) with Mizo being the dominant tribe followed by small group of immigrants from the neighbouring states like Assam, Manipur, Tripura and even from Myanmar. All the tribal communities are into modern means of livelihood. They have the same traditions, customs and usage. The most predominant indigenous group is Mizo accounting for 98% of the total indigenous people, speaking one common language called Mizo Tawng (usually known as Lusei) and follow Christianity.

IV. ANTICIPATED IMPACTS AND MITIGATION MEASURES

114. This section of the IEE reviews possible subproject-related impacts, in order to identify issues requiring further attention and screen out issues of no relevance. ADB SPS (2009) require that impacts and risks will be analyzed during pre-construction, construction, and operational stages in the context of the subproject's area of influence. As defined previously, the primary impact areas are (i) the landfill site; (ii) main routes/intersections which will be traversed by construction vehicles; and (iii) quarries and borrow pits as sources of construction materials. The secondary impact areas are: (i) entire Aizawl area outside of the delineated primary impact area; and (ii) entire Mizoram State in terms of over-all environmental improvement.

115. ADB SPS require an environmental audit of existing facilities. The main objective of is to identify past or present concerns related to impacts on the environment and determine the procedures related to action are in accordance with ADB Safeguard principal and requirements.

116. The improvement in collection and transportation component of subproject involves only procurement of vehicles and equipment and hence no impacts are anticipated during execution of this component. However, impacts are anticipated during the operational phase such as air pollution from the movement of vehicles used, improper location of containers, impacts of road wear, traffic congestion and spillage associated with transport of wastes to the disposal site or treatment facility. The health and safety of the workers involved in waste collection and transportation is another issue of operational phase. All vehicles purchased for transportation of

waste shall meet the standards prescribed by MOEF. The storage containers shall be placed in appropriate location, keeping maximum clearance from drains and canals. Only covered bins shall be provided. Regular removal of waste from the containers shall be ensured. Intensive mass awareness program shall be organized to ensure proper usage by the public. Transport routes shall be decided taking into account of the capacity of truck. Covered refuse collection vehicles have been proposed. Vehicles will be maintained periodically to prevent spillage of liquid effluent on road. Appropriate protective gears shall be provided to the workers at the site and also workers involved in collection and transportation of waste. Training shall be provided to all the workers involved in waste management regarding the dangers including the potential health effects of waste.

*(Schedule –II [See rules 6(1) and (3), 7(1)] Management of Municipal Solid Wastes: Vehicles used for transportation of wastes shall be covered. Waste should not be visible to public, nor exposed to open environment preventing their scattering. The following criteria shall be met, namely. Transportation vehicles shall be so designed that multiple handling of wastes, prior to final disposal, is avoided)

117. The ADB Rapid Environmental Assessment Checklist for Solid Waste Management in http://www.adb.org/documents/guidelines/environmental_assessment/eaguidelines002.asp was used to screen the subproject for environmental impacts and to determine the scope of the IEE investigation. The completed Checklist is found in Appendix 7 All the proposed subproject components, except the procurement of vehicles and equipment, will interact physically with the environment.

118. In the case of this subproject (i) most of the individual elements are relatively small and involve straightforward construction and operation, so impacts will be mainly localized and not greatly significant; and (ii) most of the predicted impacts are associated with the construction process, and are produced because that process is invasive, involving excavation and earth movements, will not cause direct impact on biodiversity values. (III) During Operation bad odour, generation of lechate, landfill gases, vermin and OHS will indirectly impacts the surroundings. The subproject will be in properties owned and/or acquired by the local government and access to the subproject locations is through public ROW and existing roads hence, land acquisition and encroachment on private property will not occur.

A. Pre-construction – Location and Design

119. **Location:** The dumping site used by Municipal Council had been proposed for onsite development of municipal solid waste management facilities has been evaluated on the basis of criteria as per CPHEEO & per MSWMH 2000 rule table –. All the features as described in the criteria proposed by CPHEEO & per MSWMH 2000 rule have been investigated for the chosen site. The identified area of the site (leaving 100 m distance from the river) does not have any negative parameters to be rejected based on evaluation criteria. Hence the site has been taken for detailed investigation and mitigation measures are proposed in next section.

Table 7: Site Selection Criteria and Mitigation Measures

Components	Specified limits as per CPHEEO manual	Aizawl Municipal Solid Waste Site condition	Measures
Lake or pond	More than 200 m from landfill	No	
River/ Canal	More than 100 m from landfill	No river or canal is/around the site. However there are two small seasonal streams are	In order to avoid water contamination necessary measurements like cemented floor for windrows, leachate collection system, proper cemented drainage network for composting plant and leachate treatment system should be established (please refer EMP) Additionally, a frequent monitoring system to check the water quality of canal should be incorporated.
Flood plain	More than 100 years	No	
Highway	More than 200 m from state or national highway	Yes	National highway NH-54 is approx 2 Km away from proposed site.
Habitation	More than 500 m	Yes	There is no habitation within 4 km radius of proposed site. Proper fencing and boundary wall will restrict the solid waste within the site. Moreover, green belt improves the aesthetic look. Additionally some measures to control dust and odour have already given in management plan.
Public parks	More than 300 m	Yes	There is no nation park within 4 km radius of proposed project site.
Critical Habitat Area	No habitation of endangered or protected species	No	No such species in project area.
Wetlands	Not to be in wetland	No	No such species in project area.
Ground water table	More than 2 m	Yes	Yes it's more than 2 meter.
Airport	More than 20 km	Yes	The nearest Airport is Lengpui, 32 Km from the city.
Water supply well	More than 500 m	No	There is no water supply well within 10 km of radius.
Coastal regulation zone	Not within CRZ	No	No Such area.
Unstable zone	Not within landslide/ fault zone area	Yes	The project site fall in seismic zone v.

Table 8: Site Selection Criteria and Mitigation Measures (As per MSWMH2000)

SL N.	Specified as per MSWMH 2000 rule	Aizawl Municipal Solid Waste Site condition
1	In areas falling under the jurisdiction of 'Development Authorities' it shall be the responsibility of such Development Authorities to identify the landfill sites and hand over the sites to the concerned municipal authority for development, operation and maintenance. Elsewhere, this responsibility shall lie with the concerned municipal authority.	Responsible department is UD&PA, in Aizawl very recently (in November 2010) Municipal Council has been formed but till date it is not functioning properly.
2	Selection of landfill sites shall be based on examination of environmental issues. The Department of Urban Development of the State or the Union territory shall co-ordinate with the concerned organisations for obtaining the necessary approvals and clearances.	All the environmental issues have been considered no sensitive feature has been identified. Required statutory clearance shall be taken prior to start of construction work.
3	The landfill site shall be planned and designed with proper documentation of a phased construction plan as well as a closure plan.	It has been planed accordingly.
4	The landfill sites shall be selected to make use of nearby wastes processing facility. Otherwise, wastes processing facility shall be planned as an integral part of the landfill site.	The proposed site is adjacent to existing dumping site. Composting unit has been proposed to establish as a part of Municipal Solid Waste Management Facility.
5	The existing landfill sites which continue to be used for more than five years shall be improved in accordance of the specifications given in this Schedule.	It is planned.
6	Biomedical wastes shall be disposed off in accordance with the Bio-medical Wastes (Management and Handling) Rules, 1998 and hazardous wastes shall be managed in accordance with the Hazardous Wastes (Management and Handling) Rules, 1989, as amended from time to time.	The proposed facility is only for Municipal Waste. Biomedical waste of the Aizawl city will be handled separately.
7	The landfill site shall be large enough to last for 20-25 years.	The proposed land fill site is for 25 years.
8	The landfill site shall be away from habitation clusters, forest areas, water bodies monuments, National Parks, Wetlands and places of important cultural, historical or religious interest.	No such sensitive area within a radius of 10 km. There is no human settlement within radius of 4 km of proposed project site.
9	A buffer zone of no-development shall be maintained around landfill site and shall be incorporated in the Town Planning Department's land-use plans.	A buffer zone of no-development has been proposed within boundary of 500 meters
10	Landfill site shall be away from airport including airbase. Necessary approval of airport or airbase authorities prior to the setting up of the landfill site shall be obtained in cases where the site is to be located within 20 km of an airport or airbase.	The nearest Airport is Lengpui, 32 Km from the city.

120. **Site Clearances:** The landfill site is not located within (i) 200 m of any lake or pond; (ii) 100 m of a navigable river or stream; (iii) a 100 year flood plain; (iv) within 200 m of the right of way of any state or national highway; (v) 300 m of a public park; (vi) critical habitat area; (vii) wetland; (viii) an area where water table is less than 2m below ground surface; (ix) the limits prescribed by regulatory agencies such as the MOEF, CPCB, and Aviation Authorities; (x) 500

m of any water supply well; (xi) a coastal regulation zone; and (xii) an area of potentially unstable zones such as landslide prone areas and fault zones.

121. As per the CPHEEO Guidelines, no landfill should be constructed within 100 m of a navigable river or stream. The distance may be reduced in some instances for non meandering rivers but a minimum of 30 m should be maintained in all cases. With the necessary pollution control measures (like development of leachate collection and treatment system, diversion of storm water runoff etc), there will not be any problem. Moreover, the project will improve the existing situation of crude open dumping of solid waste. “Authorization for Setting up and Operation of Disposal Facility” is already being obtained and attach as appendedix.4

122. **Social and Cultural Resources:** There is a risk that any work involving ground disturbance can uncover and damage archaeological and historical remains. For this subproject, excavation will occur in open area or existing infrastructure, so it could be that there is a medium risk of such impacts. Nevertheless SIPMIU and the Design, Supervision, and Management Consultants (DSMC) will:

(i) Consult UD&PAD(Urban Development & Poverty Alleviation Department)to obtain an expert assessment of the archaeological potential of the site;
(ii) Consider alternatives if the site is found to be of high risk;
(iii) Develop a protocol for use by the construction contractors in conducting any excavation work, to ensure that any chance finds are recognized and measures are taken to ensure they are protected and conserved.

123. **Site selection of construction work camps, stockpile areas, storage areas, and disposal areas:** Priority is to locate these near the subproject locations. However, if it is deemed necessary to locate elsewhere, sites to be considered will not promote instability and result in destruction of property, vegetation, irrigation, and drinking water supply systems. Residential areas will not be considered for setting up camps to protect the human environment (i.e., to curb accident risks, health risks due to air and water pollution and dust, and noise, and to prevent social conflicts, shortages of amenities, and crime). Extreme care will be taken to avoid disposals near the forest, water bodies, swamps, or in areas which will cause inconvenience to the community. All locations would be included in the design specifications and on plan drawings.

124. **Site selection of sources of materials:** Extraction of materials can disrupt natural land contours and vegetation resulting in accelerated erosion, disturbance in natural drainage patterns, ponding and water logging, and water pollution. To mitigate the potential environmental impacts, locations of quarry site/s and borrow pit/s (for loose material other than stones) would be included in the design specifications and on plan drawings. Priority would be sites already permitted by Mining Department. If other sites are necessary, these would to be located away from population centers, drinking water intakes and streams, cultivable lands, and natural drainage systems; and in structurally stable areas even if some distance from construction activities. It will be the construction contractor’s responsibility to verify the suitability of all material sources and to obtain the approval of Urban Local Body. If additional quarries will be required after construction is started, then the construction contractor shall use the mentioned criteria to select new quarry sites, with written approval of UD&PAD (Urban Development & Poverty Alleviation Department).

125. **Design Coverage and Service Level Improvement:** At present only 45% of the population is covered by the waste collection system. The subproject envisages 80% coverage

of the city. The service level improvement is ensured to be constant throughout the design period of the subproject.

126. **Design of Liner System:** Liner system within a landfill involves prevention of percolation of leachate from waste in landfill to the sub-soil by a suitable protective system (liner system). The liner system proposed for Aizawl comprises a combination of barrier material such as natural clay and amended soil and a flexible geo-membrane (1.5 millimeter (mm) thick HDPE sheet). The liner system will be of low permeability and will be robust, durable and to resist the chemical attack, puncture, rupture, etc.

127. **Bottom Liner for the Landfill:** The liner system is designed in compliance with the MSW Rules and will comprise a 1000 mm thick compacted clay or amended soil (Bentonite amended soil) of permeability not greater than 1x10-7cm/sec, a HDPE geo-membrane liner of thickness 1.5mm and a drainage layer of 15 cm thick granular material of permeability not greater than 1 x 10-2 cm/sec. 200 mm thick of silty sand protective layer, tamped and the top surface smooth finished. The liner should be constructed in series of lifts each of 25 cm compacted to about 15cm by four to five passes of roller.

128. **Geo-membrane Liner:** Geo-membrane is a thin sheet of flexible thermoplastic or thermo polymeric material. Because of their inherent impermeability, geo-membranes are proposed as barrier layer in landfill site. Even though geo-membranes are highly impermeable, their safety against manufacturing, installation, handling and other defects is essential criteria in design of liner system.

129. **Side lining with Geo-synthetic Clay Liner:** As per the MSW Rules 2000, the sides of the landfill also should be impervious. The side slopes in the soil formation are similarly made on firm compacted specially prepared stable slopes of 2H: 1V. The various layers of side liners from bottom to top are 600 mm thick compacted clay or amended soil of permeability not greater than 10-7 cm/sec, 1.5 mm thick High Density Polyethylene (HDPE) Geo-membrane and 100 mm thick protective layer (selected soil).

130. **Top cover Liners:** The top cover the landfill directly rests on compacted specially shaped waste surface. The bed shall be laid to 3 to 5 % slope (after allowing for pre-grade settlements of the waste) for providing good natural drainage. The various layers of liners from bottom to top are 450 mm thick granular soil (for Gas Collection layer), 600 mm thick compacted clay or amended soil ($k \leq 10\text{-}7$ cm/sec) and 300 mm thick topsoil /Sweet earth laid to 4% slope. The leachate collection tank shall be provided outside the embankment. These shall be located 0.5 m above the lowest ground level the leachate collection layer is provided in the granular soil (drainage) layer of the bottom liner system. The collection layer shall comprise of a network of perforated HDPE lateral pipes laid at a slope of 2% and 20 m c/c spacing. These laterals collect leachate and transfer it to the HDPE header pipe, which is laid at a slope of 1%. The header pipe ultimately transfers the leachate into the Leachate collection sump. The general arrangement of header and laterals is provided in the layout plan of MSW landfill. The landfill receives municipal solid waste only. All operations are planned in such a way that generation of liquid waste is minimum and the leachate directly reaches the leachate collection sump for treatment. Apart from the leachate generated as a result of inflow of rainwater into the landfill, the seepage from the moisture content present in the solid waste and the moisture present in the daily soil cover are the few sources of leachate generation. 10 % evaporation has been considered.

131. The landfill is a secured landfill with single composite liners well in place at bottom, sides and top. The liner system consists of one-layer of geomembrane and one-layer of 2ft. (600mm) thick amended clay as liners whereby the chances of gases escaping from the ground and contaminating the groundwater and soil are avoided . The gases developed due to continued confinement of degradable wastes, if any, are released through the gas extraction facilities provided in the landfill. For this purpose GI Vents are planned at every 200 c/c. Two rows of vegetative plantation shall be developed along the circumference of the outer embankment along with turfing on the slopes. In addition the top cover shall also be developed as a green belt.

(i) A site of 2 nos. each of 50 m X 25 m = 2500 sq.m area will be needed for locating the primary segregation centre and waste resource centre, toilet and wash room facility will be provided for the staff. The designed period of Resource Centre is considered as 5 years,

(ii) 1 nos. of 50 TPD Mechanical compost plant for wet waste is proposed at Tuirial land fill site. The bio-degradable waste segregated at source is collected & transported to compost plant. The process design for MSW mechanical compost plant involves various steps as described below:

- **Waste receipt and storage:** The bio-degradable waste is received in receipt area of plant through a ramp. Non-biodegradable materials like metals, papers, glass etc. are separated manually and sent for recovery or to landfill site for disposal.
- **Waste Storage & pre-processing:** Segregated waste is then taken to pre-processing area where it is further segregated and chopped in a high-speed shredder to reduce it to uniform size. The size reduction helps in faster decomposition of organic waste.
- **Mechanical (Windrow) Composting:** The shredded material is then arranged in windrow formation and is treated for odour removal. At this stage, cow dung solution is mixed with waste along with azotobacter and phosphorus solubilizing microbes (PSM) for initiating the microbial activity. In addition, water is mixed with shredded bio-degradable waste to maintain moisture content in desired range. The pre-processed waste is arranged in windrows and exposed to atmosphere for initiating microbial activity. The windrows are turned periodically for aeration using Self Propelled Windrow Turners. These windrows are left for approximately three weeks to generate partially composted waste.
- **Process Description Of Compost Plant :**
  - **a) Tipping Area:** Raw municipal solid waste will be received on Waste Receiving Platform, where manual sorting of heavy and bulky materials is carried out.
  - **b) Pre- processing Unit:** To separate out organic material and recyclable materials, Segregation is carried out though feeder conveyer, 80 mm Trommel. To shred large bulky waste into smaller pieces as they are bio-degradable in nature so shredder is proposed to provide at the compost plant at pre-processing area.
  - **c) Compost Pad:** The waste is arranged in windrows for aerobic digestion of organic materials. The aerobic digestion takes place at this platform. Here aerobic micro organisms use solid waste as an energy source and break down organic material into simpler substances. These microorganisms require air, water, and an

energy source. It is necessary to maintain proper environmental conditions for microbial life.

d) **Processing Area:** Under this section, digested garbage is subjected to separation for collection of manure. For this purpose, feeder conveyor, trommel, reject conveyor and transfer conveyor are utilized.

e) **Curing and Refinement Section:** Further refinement of collected manure is done to get better quality of manure. For this purpose, drag feeder, elevator, vibro screen, gravity separator, packing elevator and packing spout are utilized.

(iii) 2 nos. of 10 TPD each capacity Vermicompost plant for the remaining wet waste.

132. Components of a Vermicompost plant Unit Commercial units have to be developed based on availability of cow dung locally. If some big dairy is functioning then such unit will be an associated activity. Commercial units must not be designed based on imported cow dung. The philosophy is in-situ development using "Natural Resources".

(i) **Sheds.** For a vermi-composting unit, whether small or big, this is an essential item and is required for securing the vermi beds. They could be of thatched roof supported by bamboo rafters and purlins, wooden or steel trusses and stone/ RCC pillars. Locally available roofing materials or HDPE sheet may also be used in roofing to keep the capital investment at reasonably lower level. If the size is so chosen as to prevent wetting of beds due to rain on a windy day, they could be open sheds. While designing the sheds adequate room/pathways has to be left around the beds for easy movement of the labourers attending to the filling and harvesting the beds.

(ii) **Vermi-beds.** Normally the beds have 0.3 to 1 m height depending on the provision for drainage of excess water. Care should be taken to make the bed with uniform height over the entire width to avoid low production owing to low bed volumes. The bed width should not be more that 1.5 m to allow easy access to the centre of the bed. Vermi Beds of 1.8m x 1.2m x 0.75m will be adopted as per current Pilot Project practice.

(iii) **Land.** About 0.5-0.6 acre of land will be needed to set up a vermiculture production. The centre will have at least 6-8 sheds for convenience and a dedicated area for finished products. It should also have a bore well and pump set or watering arrangement and other equipments as described in the scheme economics. The land can be taken on lease for at least 10-15 years.

(iv) **Buildings.** When the activity is taken up on a large scale on commercial lines, considerable amount may have to be spent on buildings to house the office, store the raw material and finished product, provide minimum accommodation to the Manager and workers. The cost of the buildings along with the electrification of these buildings and the vermi-sheds may be included under this item.

(v) **Seed Stock.** This is an important item requiring considerable expenditure. Though the worms multiply fast to give the required numbers over a period of 6 months to a year, it may not be wise to wait till such a time having invested on the infrastructure heavily. Thus, worms @ 1 kg per m3 of bed volume should be adequate to start with and to build up the required population in about two or three cycles without unduly affecting the estimated production.

(vi) **Fencing and Roads/Paths.** The site area needs development for construction of structures and development of roads and pathways for easy movement of hand-drawn trolleys/wheel barrows for conveying the raw material and the finished

products to and from the vermi-sheds. The entire area has to be fenced to prevent trespass by animals and other unwanted elements. These could be estimated based on the length of the periphery of the farm and the length and type of roads/paths required. The costs on fencing and formation of roads should be kept low as these investments are essential for a production unit, yet would not lead to increase in production.

(vii) **Water Supply System.** As the beds have to be kept moist always with about 50% moisture content, there is a need to plan for a water source, lifting mechanism and a system of conveying and applying the water to the vermi-beds. Drippers with round the clock flow arrangement would be quite handy for continuous supply and saving on water. Such a water supply system requires considerable initial investment. However, it reduces the operational cost on hand watering and proves economical in the long run. The cost of these items would depend on the capacity of the unit and the type of water supply chosen.

(viii) **Machinery.** Farm machinery and implements are required for cutting (shredding) the raw material into small pieces, conveying shredded raw material to the vermi-sheds, loading, unloading, collection of compost, loosening of beds for aeration, shifting of the compost before packing and for air drying of the compost, automatic packing and stitching for efficient running of the unit.

(ix) **Transportation.** For any vermi-composting unit transport arrangement is a must. When the source of raw material is away from the production unit, an off-site transport becomes major item of investment. A large sized unit with about 1000 tonnes per annum capacity may require a three tonne capacity mini-truck. With small units particularly with the availability of raw material near the site, expending on transport facility may become in fructuous. On-site transport facilities like manually drawn trolleys to convey raw material and finished products between the storage point and the vermi-compost sheds could also be included in the project cost.

(x) **Furniture.** A reasonable amount could also be considered for furnishing the office-cum-stores including the storage racks and other office equipments. This will enhance the efficiency of operations.

133. **Landfill Operations and Maintenance Manual:** The landfill needs to be operated in a uniform manner so its integrity is maintained and utmost environmental protection is maintained. The Landfill Operations and Maintenance (O&M) Manual will be prepared as part of the subproject by the O&M contractor to detail the operational procedures to be followed and implemented to ensure compliance with the intended construction and operation standards. Its purposes (Appendix 9) include: (i) provide information on the basic components of the landfill; (ii) familiarize the Operator with the various containment units and environmental control/monitoring systems; (iii) familiarize the Operator with the general operational phasing or sequencing of waste filling; (iv) provide basic engineering controls for the landfill construction in conformance to design requirements; (v) provide basic information on the type and purpose of the landfill heavy equipment and their maintenance requirements; (vi) provide instruction on daily waste filling operations including load inspection procedures, spreading and compaction of waste, and application of cover; (vii) provide procedures for operating under inclement or wet weather operations; (viii) provide general procedures for emergency response and management; (ix) provide a detailed description of environmental monitoring and inspections; and (x) familiarize the Operator with safety procedures related to landfill operations.

134. Environmental Monitoring Program: The CPHEEO Manual recommends establishment of the following baseline parameters for one (1) year prior to construction of the landfill:

(i) Ground Water Quality—minimum of 3 samples from each aquifer analysed in monthly basis for drinking water quality parameters;
(ii) Surface Water Quality—minimum of 3 samples from a stream/storm water drain analysed on a monthly basis and for parameters relevant for wastewater drains;
(iii) Landfill Gas—sampling and analysis for methane, hydrogen sulphide and other gases on a monthly basis;
(iv) Dust—particulate matter less than 10 microns (PM10) monitoring on a monthly basis, specifically at noon, during hot, dry and windy days;
(v) Odour—monthly analysis at the site and at 200-m intervals from the landfill boundary to the nearest inhabited zone;
(vi) Noise—Peak noise analysis at the site and nearby inhabited zone on a monthly basis; and
(vii) Vegetative Cover—vegetative mapping on a seasonal basis.

135. (i) The soil formation of tuirial, in general, is of loose sedimentary type, with high porosity and permeability. This results in the city being highly susceptible to erosion and rain induced landslides, leading to severe damages to property and lives every year. Soils vary from sandy loam and clayey loam to clay, generally mature but leached owing to steep gradient and heavy rainfall. The soils are porous with poor water holding capacity, deficient in potash, phosphorous, nitrogen and even humus due to the traditional practice of shifting cultivation. The pH shows acidic to neutral reaction due to excessive leaching (Environment & Forest Department Report 2003). Shifting cultivation principally practiced in Mizoram affects soil productivity through increase of soil acidity, lowering of surface moisture and intensifying erosion losses of soil and nutrients through runoff. The result of soil quality measured at land fill site has been given Table no 9

Table 9: Soil Quality at Landfill Site

Sl.No.	Parameters	Sampling location
		Land Fill Site, Tuirial
1	Appearance	Greyish powder
2	pH (1:5) at 270C	5.61
3	Electro Conductivity at 250C (in µs/cm)	40.0
4	Bulk Density (gm/cc)	1.1
5	Moisture in %	7.08
6	Organic matter in %	1.38
7	Sand in % (W/W)	2.5
8	Silt in % (W/W)	7.20
9	Clay in % (W/W)	90.30
10	Texture (W/W)	Clay
11	Porosity in %	56.0
12	Water Holding Capacity in %	68.60
13	Sodium as Na (mg/kg)	50.0
14	Phosphorus as P in mg/kg	0.201
15	Available Chlorides in mg/kg	78.38
16	Alkalinity (mg/kg)	Nil
17	Total Iron as Fe in mg/kg	11,963
18	Potassium as K (mg/kg)	35.0
19	Cadmium as Cd (mg/kg)	0.48
20	Copper as Cu (mg/kg)	8.04
21	Zinc as Zn (mg/kg)	24.15
22	Nitrogen in mg/kg	151.28

136. Ambient air quality monitoring was carried out as per the guidelines of CPCB to establish the air quality of the study area. The main sources of air pollution in the study area are vehicular emission, demolition, grinding, and burn of agriculture practised. The duration of sampling of SPM, PM 10, PM 2.5 Sulphur dioxide (SO2), Oxides of Nitrogen (NO2) CO2, and CH4) was each 24 and 8 hours (As per standards prescribed in Revised National Ambient Air Quality Standard dated 16th Nov. 2009). The monitoring was conducted for two days in a week. The result of air quality measured at land fill site has been given Table 10.

Table 10: Ambient Air Quality at Landfill Site

SAMPLING LOCATION	EXISTING LAND FILL SITE (TURIALS NH-54)
DATE OF SAMPLING	11.01.2012 TO 12.01.2012
TEST START DATE	16.01.2012
TEST END DATE	08.02.2012

SL No	TESTS	PROTOCOL	RESULT	Limit as per National Ambient Air Quality Standards (Schedule VII)
1	Sulphur Dioxide (SO_2), $\mu g/m^3$	IS 5182:Part 2:2001	<4.0	80
2	Nitrogen Dioxide (NO_2), $\mu g/m^3$	IS 5182:Part 6:2006	5.1	80
3	Particulate Matter (size less than 10µm) or PM_{10} $\mu g/m^3$	IS 5182 Part-23:2006	196.1	100
4	Particulate Matter (size less than 2.5µm) or $PM_{2.5}$ $\mu g/m^3$	USEPA CFR40(50), Appendix L	65.1	60
5	Ozone (O_3), $\mu g/m^3$	APHA 3rd Edn. 2005(411)	<6.0	180
6	Lead (Pb), $\mu g/m^3$	APHA 3rd Edition:2005(315)	0.018	1.0
7	Carbon Monoxide (CO), mg/m^3	IS 5182:Part 10:1999(Reaff.2003)	Not Detected*	02
8	Ammonia (NH_3), $\mu g/m^3$	APHA 3rd Edition-Method 401	<20.0	400
9	Benzene(C_6H_6), $\mu g/m^3$	ASTM-D-3687-2001	BDL**	05
10	Benzo(a) Pyrene (BaP)-particulate phase only, ng/m^3	USEPA 3542 & USEPA 8270C	BDL	01
11	Arsenic (As), ng/m^3	APHA 3rd Edition (302)	<2.0	06
12	Nickel (Ni), ng/m^3	APHA 3rd Edition (302)	<2.0	20
13	Carbon Dioxide(CO_2) (ppm)	GC-FID Methanizer	388.45	---
14	Methane (ppm)	IS:5182(Part-17)-1979 (Reaff.2003)	155.96	---
15	Suspended Particulate Matter (SPM) $\mu g/m^3$	IS 5182 Part 4:1999 (Reaff.2005)	322.1	---

137. Groundwater sample was collected from four bore well and analysed. Groundwater quality conforms the drinking water stand (IS:10500) as appended in Appendix 4.0.Results of groundwater analysis has been summarised in Table 11

Table 11: Groundwater Quality at Landfill Site

TESTS	PROTOCOL	RESULT
AMMONIACAL NITROGEN (AS N)	APHA 21 st EDN.:2005 (4500-NH3-B&C)	<0.10 mg/l
ARSENIC	APHA 21 st EDN.:2005 (3120B)	<0.005 mg/l
B.O.D @27°C for 3 days	IS 3025:PART 44:1993(Reaff.1999)	<2 mg/l
C O D	APHA 21 st EDN.:2005 (5220B)	<5 mg/l
CADMIUM	APHA 21 st EDN.:2005 (3120B)	<0.005 mg/l
CHLORIDES	APHA 21 st EDN.:2005 (4500-Cl-B)	3.59 mg/l
CHROMIUM	APHA 21 st EDN.:2005 (3120B)	<0.01 mg/l
COPPER	APHA 21 st EDN.:2005 (3120B)	<0.01 mg/l
CYANIDE (as CN)	APHA 21 st EDN.:2005 (4500-CN-C&E)	<0.02 mg/l
FLUORIDE	APHA 21 st EDN.:2005 (4500-F-G)	0.13 mg/l
KJELDAL NITROGEN (AS N)	APHA 21 st EDN.:2005(4500 N-B)	<1.0 mg/l
LEAD	APHA 21 st EDN.:2005 (3120B)	0.02 mg/l
MERCURY	APHA 21 st EDN.:2005 (3112B)	<0.001 mg/l
BY ICPOES		
NICKEL	APHA 21 st EDN.:2005 (3120B)	<0.01 mg/l
pH	APHA 21st EDN.:2005 (4500-H-B)	8.23 °
PHENOLIC COMPOUND as C6H5OH	APHA 21 st EDN.:2005 (5530 C)	<0.001 mg/l
T.S.S.	APHA 21 st EDN.:2005 (2540 D)	<5 mg/l
TOTAL DISSOLVED SOLIDS (INORGANIC)	APHA 21stEDN. 2005 (2540C)	94 mg/l

138. Surface water sample was collected from Muthi River near present waste dump site and analysed. Surface water quality conforms the surface water Quality standard (CPCB). Results of surface water analysis has been summarised in Table 12

Table 12: Surface Water Quality at Landfill Site

TESTS	PROTOCOL	RESULT		
PESTICIDE RESIDUES AS PER ANNEX D OF IS:14543:2004	IS 14543:2004			
PESTICIDE RESIDUES AS PER ANNEX D OF IS:14543:2004				
Alpha HCH	EPA 3510 C & 8081A	BDL (DL:0.00001 mg/kg)*	-	0.0001mg/l
Beta HCH	EPA 3510 C & 8081A	BDL (DL:0.00001 mg/kg)*	-	0.0001mg/l
Gama - HCH (Lindane)	EPA 3510 C & 8081A	BDL (DL:0.00001 mg/kg)*	-	0.0001mg/l
Delta -HCH	EPA 3510 C & 8081A	BDL (DL:0.00001 mg/kg)*	-	0.0001mg/l
O,P-DDT	EPA 3510 C & 8081A	BDL (DL:0.00001 mg/kg)*	-	0.0001mg/l
P,P-DDT	EPA 3510 C & 8081A	BDL (DL:0.00001 mg/kg)*	-	0.0001mg/l
O,P-DDD	EPA 3510 C & 8081A	BDL (DL:0.00001 mg/kg)*	-	0.0001mg/l
P,P-DDD	EPA 3510 C & 8081A	BDL (DL:0.00001 mg/kg)*	-	0.0001mg/l
O,P-DDE	EPA 3510 C & 8081A	BDL (DL:0.00001 mg/kg)*	-	0.0001mg/l
P,P-DDE	EPA 3510 C & 8081A	BDL (DL:0.00001 mg/kg)*	-	0.0001mg/l
Alpha -Endosulfan	EPA 3510 C & 8081A	BDL (DL:0.00001 mg/kg)*	-	0.0001mg/l
Beta -Endosulphan	EPA 3510 C & 8081A	BDL (DL:0.00001 mg/kg)*	-	0.0001mg/l
Endosulfan sulphate	EPA 3510 C & 8081A	BDL (DL:0.00001 mg/kg)*	-	0.0001mg/l
Monocrotophos	EPA 3510 C & 8141A	BDL (DL:0.00001 mg/kg)*	-	0.0001mg/l
Ethion	EPA 3510 C & 8141A	BDL (DL:0.00001 mg/kg)*	-	0.0001mg/l
Chlorpyrifos	EPA 3510 C & 8141A	BDL (DL:0.00001 mg/kg)*	-	0.0001mg/l
Phorate	EPA 3510 C & 8141A	BDL (DL:0.00001 mg/kg)*	-	0.0001mg/l
Phorate sulphoxide	EPA 3510 C & 8141A	BDL (DL:0.00001 mg/kg)*	-	0.0001mg/l
Phorate sulphone	EPA 3510 C & 8141A	BDL (DL:0.00001 mg/kg)*	-	0.0001mg/l
2 , 4 - D	EPA 3510 C & 8151A	BDL (DL:0.00001 mg/kg)*	-	0.0001mg/l
Butachlor	EPA 3510 C & 8081A	BDL (DL:0.00001 mg/kg)*	-	0.0001mg/l
Isoproturon	BY LC-MS/MS	BDL (DL:0.00001 mg/kg)*	-	0.0001mg/l
Alachor	EPA 3510 C & 8081A	BDL (DL:0.00001 mg/kg)*	-	0.0001mg/l
Atrazine	EPA 3510 C & 8141A	BDL (DL:0.00001 mg/kg)*	-	0.0001mg/l
Methyl Parathion	EPA 3510 C & 8141A	BDL (DL:0.00001 mg/kg)*	-	0.0001mg/l
Methyl Paraoxan	EPA 3510 C & 8141A	BDL (DL:0.00001 mg/kg)*	-	0.0001mg/l

TESTS	PROTOCOL	RESULT
ALKALINITY as CaCO3	APHA 21ST EDN.2005(2320B)	97.60 mg/l
ALUMINIUM	APHA 21 st EDN.:2005 (3120-B)	<0.02 mg/l
ANIONIC SURFACE ACTIVE AGENTS	APHA 21 st EDN.:2005(5540 B&C)	<0.05 mg/l
ARSENIC	APHA 21 st EDN.:2005 (3120B)	<0.005 mg/l
B.O.D @27 °C for 3 days	IS 3025:PART 44:1993(Reaff.1999)	2 mg/l
BORON as B	APHA 21 st EDN.:2005(3120B)	0.05 mg/l
CADMIUM	APHA 21 st EDN.:2005 (3120B)	<0.005 mg/l
CALCIUM	APHA 21 st EDN.:2005 (3500-Ca-B)	16.13 mg/l
CHLORIDES	APHA 21 st EDN.:2005 (4500-Cl-B)	10.05 mg/l
CHROMIUM	APHA 21 st EDN.:2005 (3120B)	<0.01 mg/l
COD	APHA 21 st EDN.:2005 (5220 B)	<5 mg/l
COLOUR (HAZEN UNITS)	APHA 21 st EDN.:2005 (2120 B)	5
COPPER	APHA 21 st EDN.:2005 (3120B)	<0.01 mg/l
CYANIDE (as CN)	APHA 21 st EDN.:2005 (4500-CN-C&E)	<0.05 mg/l
DISSOLVED OXYGEN	APHA 21 st EDN.:2005 (4500-O-C)	5.8 mg/l
FLUORIDE	APHA 21 st EDN.:2005 (4500-F-G)	<0.10 mg/l
IRON	APHA 21 st EDN.:2005 (3120B)	0.07 mg/l

139. Soil Investigation has been done at Tuirial Landfill Site to study the stratification and making classification of physical properties of the soils. The soil Survey carried out and deals with the aspects relating to classification of soils and stratification. Results of surface water analysis has been summarised in Table 13 & 14

Method of Boring : Standard Penetration Test
Bore Hole No : 1
Depth of Boring : 3.65 M

Table 13: Result of Table Water Analysis (a)

Depth (m)	Description of Strata	Soil Denseness	Strata		Sample			Run (m)		C. R. %age	RQD %ag e	S.P.T . "N" value
			Legend	Thickness (m)	Type	No	Depth (M)	From	To			
1	Reddish	Loose			SPT UDS	S-11	0.95	0.65	0.95			6
		Medium			SPT UDS	S-12	1.40	1.10	1.40			13
		Medium			SPT UDS	S-13	1.85	1.55	1.85			14
2		Medium			SPT UDS	S-14	2.30	2.00	2.30			19
		Medium			SPT UDS	S-15	2.75	2.45	2.75			26
3	Grey (Soft Rock)	Very Dense			SPT UDS	S-16	3.20	2.90	3.20			74
		Very Dense			SPT UDS	S-17	3.65	3.35	3.65			110

Abbreviation: UDS: Undisturbed Soil D: Disturbed RQD: Rock Quality Designation
CR: Core Recovery SPT: Standard Penetration Test

Project : Taking Trail Bore Hole at Tuirial Landfill Site at Tuirial
Method of Boring : Standard Penetration Test
Bore Hole No : 2
Depth of Boring : 6.35 M
Date Completed : 28/10/2011

Table 14: Result of Table Water Analysis (b)

Depth (m)	Description of Strata	Soil Denseness	Strata		Sample			Run (m)		C. R. %age	RQD %ag e	S.P.T . "N" value
			Legend	Thickness (m)	Type	No	Depth (M)	From	To			
1	Brown Soil	Medium			SPT UDS	S-21	0.95	0.65	0.95			12
		Medium			SPT UDS	S-22	1.40	1.10	1.40			12
		Loose			SPT UDS	S-23	1.85	1.55	1.85			7
2	Brown Soil	Loose			SPT UDS	S-24	2.30	2.00	2.30			6
		Loose			SPT UDS	S-25	2.75	2.45	2.75			10
3	Reddish	Medium			SPT UDS	S-26	3.20	2.90	3.20			12
		Loose			SPT UDS	S-27	3.65	3.35	3.65			9
4	Reddish	Medium			SPT UDS	S-28	4.10	3.80	4.10			15
		Medium			SPT UDS	S-29	4.55	4.25	4.55			13
5	Reddish	Dense			SPT UDS	S-210	5.00	4.70	5.00			32
		Medium			SPT UDS	S-211	5.45	5.15	5.45			12
		Medium			SPT UDS	S-212	5.90	5.60	5.90			14
6	Reddish	Medium			SPT UDS	S-213	6.35	6.05	6.35			21

Abbreviation: UDS: Undisturbed Soil D: Disturbed RQD: Rock Quality Designation: CR: Core Recovery SPT: Standard Penetration Test

140. **Screening of Wastes Received.** Waste acceptance and screening procedures will be part of the Landfill O&M Manual to ensure that the site does not accept wastes that are prohibited from entry. Hazardous/biomedical wastes will not be placed in the landfill. Signs will be prominently displayed at the point of entry to clearly indicate the types of wastes that are allowed and those that are not to be accepted.

141. **Security.** The boundary walls will be marked and a billboard will be placed at the gate and at conspicuous locations in the landfill site to indicate that unauthorized access, illegal dumping, burning, and squatting are prohibited. Security will be provided to ensure that illegal dumping, theft, and unauthorized access do not happen.

142. **Traffic Investigation.** Traffic investigations will be conducted to identify peak traffic volume as well as the quality of existing roads near the landfill. The influence of increased heavy vehicle traffic due to land filling will be analyzed with a view to widening the existing road.

143. **Post-Closure Usage.** The landfill once used up to its full capacity will be closed and rehabilitated. Establishment of permanent structures will not be allowed on any part of the closed landfill as decomposition of the underlying waste and release of gases will lead to settlement of the ground.

144. **Climate Change.** Aizawl will make a significant contribution to reducing the impact of its solid wastes, in terms of reducing greenhouse emissions, predominantly through the management of landfill gases and composting.

B. Construction

145. **Screening of No Significant Impacts.** The construction work is expected not to cause major negative impacts, mainly because:

(i) Most of the activities will not be on the built-up areas of Aizawl city and/or existing ROWs thus could be constructed without causing impacts to biodiversity.
(ii) The site is located on government-owned land which is not occupied or used for any other purpose.
(iii) Overall construction program will be relatively short and is expected to be completed in 12 months with activities to conducted by small teams and specified location so most impacts will be localized and short in duration.
(iv) Most of the predicted impacts associated with the construction process are produced because the process is invasive, such as involving excavation. However the routine nature of the impacts means that most can be easily mitigated and the impacts are clearly a result of the construction process rather than the design or location, as impacts will not occur if excavation or other ground disturbance is not involved.

146. As a result, there are several aspects of the environment which are not expected to be affected by the construction process and these can be screened out of the assessment at this stage as required by ADB procedure. These are shown in Table15. These environmental factors are screened out presently but will be assessed again before starting of the construction activities.

Table 15: Field in which Construction is expected not to have Significant Impacts

Field	Rationale
Topography, Soils, and Geology	Activities are not large enough to affect these features.
Climate	Activities are not large enough to affect this feature.
Air Quality	Short-term production of dust is the only effect on atmosphere
Groundwater	Activities will not be large enough to affect these features
Ecological Resources - Protected Areas	Construction-related transport activities (hauling of materials and disposal of wastes) will not affect the forested area nearby.
Flora and Fauna	No rare or endangered species in the landfill site.
Economic Development	Activities are not large enough to permanently affect this feature.
Land Use	No change in land use.
Socio-economic	Subproject site is located entirely on government-owned land so there is no need to acquire land from private owners.
Commerce, Industry, and Agriculture	Activities are not large enough to affect these features
Population	Activities are not large enough to affect this feature.
Health and education facilities	Activities are not large enough to affect this feature.
Religious sites	No religious sites within the two subproject sites.
Historical, Archaeological, Paleontological, or Architectural sites	No scheduled or unscheduled historical, archaeological, paleontological, or architectural sites

C. Construction Method

147. Construction of the landfill will begin with excavation by backhoe diggers and bulldozers. Once sloping sides are stabilized, a clay layer will be created, by watering and compacting the existing soil if it is of the required composition, or by importing a clay and Bentonite mixture, which will be applied from trucks and smoothed and finished by hand. This will be covered with a HDPE geo linear, and perforated plastic pipes will be laid on the surface to collect leachate, which will drain into small shallow evaporation ponds dug in an adjacent part of the site. Finally a 20 cm depth of gravel will be added above the geo-textile HDPE linear to allow leachate to drain into the pipes.

148. Construction of the subproject components involves quite simple techniques of civil work, the invasive nature of excavation will only occur at the landfill site. Where there is no human commercial activities, impacts to the environment and sensitive receptors is bound to overcome in general. These anticipated impacts are temporary and for short duration. Physical impacts will be reduced by the method of working and scheduling of work, whereby the project components will be (i) constructed by small teams working at a time; and (ii) any excavation done near sensitive area like school, religious places and house will be protected as per standard norms etc.

149. **Sources of Materials.** Significant amount of gravel, sand, and cement will be required for this subproject. The construction contractor will be required to:

(i) use quarry sites and sources permitted by government;
(ii) verify suitability of all material sources and obtain approval of SIPMIU; and
(iii) submit to DSMC on a monthly basis documentation of sources of materials.

150. **Air Quality:** It is most certain that work will be conducted during the dry season, so there is potential for creating dust from the excavation of dry soil, backfilling, transportation to disposal, and from the import and storage of sand/gravel for bedding. Emissions from construction vehicles, equipment, and machinery used for excavation and construction will also induce impacts on the air quality in the construction sites. Anticipated impacts include dusts and increase in concentration of vehicle-related pollutants such as carbon monoxide, sulfur oxides, particulate matter, nitrous oxides, and hydrocarbons) but temporary and during construction activities only. To mitigate the impacts, construction contractors will be required to:

(i) consult with SIPMIU/DSMC on the designated areas for stockpiling of clay, soils, gravel, and other construction materials;
(ii) damp down exposed soil and any stockpiled on site by spraying with water when necessary during dry weather;
(iii) bring materials (aggregates) as and when required;
(iv) use tarpaulins to cover sand and other loose material when transported by vehicles;
(v) fit all heavy equipment and machinery with air pollution control devices which are operating correctly; and
(vi) Clean wheels and undercarriage of vehicles prior to leaving construction site.

151. **Surface Water Quality:** Due to hilly topography and high intensity rainfall, there is likely large scale erosion from construction areas. This may lead to silting and blockage of drains and water bodies. These potential impacts are temporary and short-term duration only and to ensure these are mitigated, construction contractor will be required to:

(i) Avoid stockpiling of earth fill especially during the monsoon season unless covered by tarpaulins or plastic sheets;
(ii) Prioritize re-use of excess spoils and materials in the construction works. If spoils will be disposed, consult with SIPMIU/DSMC on designated disposal areas;
(iii) install temporary silt traps or sedimentation basins along the drainage leading to the water bodies;
(iv) Place storage areas for fuels and lubricants away from any drainage leading to water bodies;
(v) Dispose any wastes generated by construction activities in designated sites only; and
(vi) Conduct surface quality inspection according to the Environmental Management Plan (EMP).

152. **Noise Levels:** The rock cutting (rock blasting is not required) will certainly generate noise and vibrations. The sensitive receptors are the general population in these areas. Noise will be for a short term thus impact is negative, short-term, and reversible by mitigation measures. The construction contractor will be required to:

(i) plan activities in consultation with SIPMIU/DSMC so that activities with the greatest potential to generate noise are conducted during periods of the day which will result in least disturbance;
(ii) provide prior information to the local public about the work schedule;
(iii) require horns not to be used unless it is necessary to warn other road users or animals of the vehicle's approach;
(iv) ensure that there are no old and sensitive buildings that may come under risk due to the use of pneumatic drills; if there is risk, cut the rocks manually by chiselling; and

(v) minimize noise from construction equipment by using vehicle silencers, fitting jackhammers with noise-reducing mufflers, and portable street barriers the sound impact to surrounding sensitive receptor.

153. **Landscape and Aesthetics:** The construction work is likely to generate significant quantities of waste soil and debris. This activity will generate wood, metal and concrete debris. Indiscriminate disposal of the soil and waste may affect the local environment at the disposal location. These impacts are negative but short-term and reversible by mitigation measures. The construction contractor will be required to:

(i) prepare and implement Waste Management Plan;
(ii) avoid stockpiling of excess excavated soils;
(iii) avoid disposal of any debris and waste soils in the forest areas and in or near water bodies/rivers;
(iv) coordinate with UD&PAD for beneficial uses of excess excavated soils or immediately dispose to designated areas;
(v) recover wood, metal, used oil, and lubricants and reuse or remove from the sites;
(vi) manage solid waste according to the following preference hierarchy: reuse, recycling and disposal to designated areas;
(vii) remove all wreckage, rubbish, or temporary structures which are no longer required; and
(viii) request SIPMIU/DSMC to report in writing that the necessary environmental restoration work has been adequately performed before acceptance of work.

154. **Accessibility**: No excavation on roads is required for the solid waste management component so no traffic disruption is anticipated. However, in the event any activities are carried out on roads, the construction contractor will be required to:

(i) conduct work during light traffic;
(ii) do not close the road completely, ensure that work is conducted onto edge of the road; allow traffic to move on one line;
(iii) in unavoidable circumstances of road closure, provide alternative routes, and ensure that public is informed about such traffic diversions;
(iv) in case of closure of main roads, provide information to the public through media – daily news papers and local cable television (TV) services, about the need and schedule of road closure, and alternative routes; and
(v) at all work sites public information/caution boards shall be provided – information shall inter-alia include: project name, cost and schedule; executing agency and contractor details; nature and schedule of work at that road/locality; traffic diversion details, if any; entry restriction information; competent official's name and contact for public complaints.

155. **Socio-Economic – Income**. Excavation will not obstruct access to residences/commercial building as the site is at the outskirt of the city. No disruption of access is expected. The potential impacts are negative and moderate but short-term and temporary. The construction contractor will be required to:

(i) leave space for access between mounds of excavated soil;
(ii) provide wooden planks/footbridges for pedestrians and metal sheets for vehicles to allow access across trenches to premises where required;
(iii) consult affected businesspeople to inform them in advance when work will occur;
(iv) address livelihood issues; implement the Resettlement Plan to address these issues;

(v) provide prior public information about the work schedule in particular locality and the traffic diversions/changes in any – information shall disseminated through local papers and cable television services;
(vi) provide sign/caution/warning boards at work site indicating work schedule and traffic information; prevent public entry into work sites through barricading and security; and
(vii) provide sign boards for pedestrians to inform nature and duration of construction works and contact numbers for concerns/complaints.

156. **Socio-Economic – Employment**. Manpower will be required during the 12-months construction stage. This can result to generation of contractual employment and increase in local revenue. Thus potential impact is positive and long-term. The construction contractor will be required to:

(i) employ at least 50% of the labour force, or to the maximum extent, local persons within the 2-km immediate area if manpower is available;
(ii) employ women with same amount of pay for doing same amount of work with men; and
(iii) secure construction materials from local market.

157. **Occupational Health and Safety.** Workers need to be mindful of the occupational hazards which can arise from working in height and excavation works. Potential impacts are negative and long-term but reversible by mitigation measures. The construction contractor will be required to:

(i) Develop and implement site-specific Health and Safety (H&S) Plan which will include measures such as: (a) excluding public from the site; (b) ensuring all workers are provided with and use Personal Protective Equipment; (c) H&S Training4 for all site personnel; (d) documented procedures to be followed for all site activities; and (e) documentation of work-related accidents.
(ii) Ensure that qualified first-aid can be provided at all times. Equipped first-aid stations shall be easily accessible throughout the site.
(iii) Provide medical insurance coverage for workers.
(iv) Secure all installations from unauthorized intrusion and accident risks.
(v) Provide supplies of potable drinking water.
(vi) Provide clean eating areas where workers are not exposed to hazardous or noxious substances.
(vii) Provide H&S orientation training to all new workers to ensure that they are apprised of the basic site rules of work at the site, personal protective protection, and preventing injuring to fellow workers.
(viii) Provide visitor orientation if visitors to the site can gain access to areas where hazardous conditions or substances may be present. Ensure also that visitor/s do not enter hazard areas unescorted.

[4] Some of the key areas that may be covered during training as they relate to the primary causes of accidents include (i) slips, trips and falls; (ii) personal protective equipment; (iii) ergonomics, repetitive motion, and manual handling; (iv) workplace transport; and (v) legislation and responsibilities. Training can provide the foundations of competence but it does not necessarily result in a competent worker. Therefore, it is essential to assess staff competence to ensure that the training provided is relevant and effective. Supervision and monitoring arrangements shall be in place to ensure that training has been effective and the worker is competent at their job. The level of supervision and monitoring required is a management decision that shall be based on the risks associated with the job, the level of competence required, the experience of the individual and whether the worker works as part of a team or is a lone worker.

(ix) Ensure the visibility of workers through their use of high visibility vests when working in or walking through heavy equipment operating areas.
(x) Ensure moving equipment is outfitted with audible back-up alarms.
(xi) Mark and provide sign boards for hazardous areas such as energized electrical devices and lines, service rooms housing high voltage equipment, and areas for storage and disposal. Signage shall be in accordance with international standards and be well known to, and easily understood by workers, visitors, and the general public as appropriate.
(xii) Disallow worker exposure to noise level greater than 85 dBA for a duration of more than 8 hours per day without hearing protection. The use of hearing protection shall be enforced actively.

158. **Community Health and Safety.** Hazards posed to the public, specifically in high-pedestrian areas may include traffic accidents and vehicle collision with pedestrians. In most of the cases location of project sites at isolated area, hence health and safety risk to community is minimum. Potential impact is negative but short-term and reversible by mitigation measures. The construction contractor will be required to:

(i) Plan routes to avoid times of peak-pedestrian activities.
(ii) Liaise with SIPMIU/DSMC in identifying risk areas on route cards/maps.
(iii) Regularly maintain the vehicles and use of manufacturer-approved parts to minimize potentially serious accidents caused by equipment malfunction or premature failure.
(iv) Provide road signs and flag persons to warn of dangerous conditions, in case of location near the road.

159. **Quarry Sites and Borrow Pits.** Extraction of clay, soils, stones, aggregates, and loose materials other than stones can cause disruption of natural land contours and vegetation resulting in accelerated erosion, landslides, disturbance in natural drainage patterns, sedimentation/siltation of surface waters, and water pollution. Extraction of rocks and materials from river beds can result in endangerment of bridges and continuous degradation of the river regime. Potential impacts are negative and can be long-term and irreversible thus the construction contractor will be required to:

(i) Verify suitability of all material sources and obtain approval of DSMC.
(ii) Prioritize government-approved quarries and borrow pits.
(iii) Obtain approval of DSMC if new quarries and borrow sites are necessary.
(iv) Obtain approval of DSMC if extracting rocks, gravel, and sand from small rivers or streams is necessary. The extraction points shall be spread out along the length of the river to minimize disruption in river flow and to prevent instability to embankments. Local residents and water users shall be consulted to ensure that irrigation intakes, bunds, and local fishing are not adversely impacted.
(v) Request DSMC to report in writing that the necessary environmental restoration work has been adequately performed before acceptance of work.

160. **Work Camps.** Operation of work camps can cause temporary air and noise pollution from machine operation, water pollution from storage and use of fuels, oils, solvents, and lubricants. Potential impacts are negative but short-term and reversible by mitigation measures. The construction contractor will be required to:

(i) Consult with SIPMIU/DSMC before locating project offices, sheds, and construction plants.
(ii) Minimize removal of vegetation and disallow cutting of trees.
(iii) Provide water and sanitation facilities for employees.

(iv) Prohibit employees from poaching wildlife and cutting of trees for firewood.
(v) Train employees in the storage and handling of materials which can potentially cause soil contamination.
(vi) Recover used oil and lubricants and reuse or remove from the site.
(vii) Manage solid waste according to the following preference hierarchy: reuse, recycling and disposal to designated areas.
(viii) Remove all wreckage, rubbish, or temporary structures which are no longer required.
(ix) Request SIPMIU/DSMC to report in writing that the camp has been vacated and restored to pre-project conditions before acceptance of work.

161. **Social and Cultural Resources** – Chance Finds. For this subproject, excavation will occur at specific isolated location, so it could be that there is a low risk of such impacts. Nevertheless, the construction contractor will be required to:

(i) Strictly follow the protocol for chance finds in any excavation work.
(ii) Request SIPMIU/DSMC or any authorized person with archaeological/historical field training to observe excavation, if deemed necessary by local authorities.
(iii) Stop work immediately to allow further investigation if any finds are suspected.
(iv) Inform SIPMIU/DSMC if a find is suspected, and take any action they require ensuring its removal or protection in situ.

D. Operation and Maintenance

1. Screening out Areas of No Significant Impact

162. The landfill is located outside the town in an uninhabited and unused. Collection vehicles will be confined to pre-determined routes and will not need to traverse inside communities as collection points will be established. Thus there are several fields that are not expected to have significant impacts during the operation and maintenance stage of the subproject (Table 16).

Table 16: Fields in which Operation and Maintenance is not Expected to have Significant Impacts

Field	Rationale
Location and administrative boundaries	No impact expected
Topography, soil, and geology	O&M activities are not large enough to affect these features.
Climate	O&M activities are not large enough to affect these features.
Air Quality	O&M activities are not large enough to affect these features.
Groundwater	O&M activities are not large enough to affect these features.
Ecological Resources	O&M activities are not large enough to affect these features.
Land Use	O&M activities are not large enough to affect these features.
Local Economy – Industries, Trade, and Commerce	O&M activities are not large enough to affect these features.
Population	O&M activities are not large enough to affect these features.
History, Culture and Tourism	O&M activities are not large enough to affect these features.

2. Mode of Operation

163. **Management**: AMC will be responsible for management and implementation of the solid waste management system, and will distribute bins to households in the town (two bins per household) for temporary waste storage. This will be supported by a public education campaign, through which citizens will be requested to segregate their biodegradable and general domestic waste into separate bins, and will be informed about the waste collection and management system.

164. **Collection**: AMC will introduce door-to-door primary waste collection throughout the city by its own staff or through private sector participation (PSP) by a local contractor or nongovernmental organization (NGO). Mobile garbage bins will collect waste from each household on a regular cycle every day or every two or three days, and the segregated waste will be deposited into separate trucks. Waste will also be removed from litter bins in the streets, and debris from street sweeping and drain de-silting will also be deposited into the municipal storage bins. These will be removed daily by purpose-made vehicles, and two empty bins will be replaced at each site.

165. **Transportation**: Full containers will be transported to the landfill and deposit the waste in the designated slot in the landfill area.

166. **Disposal**: Waste for land filling will be moved into position in the currently-used cell by bulldozer and backhoe, and reduced in volume by a compactor vehicle. All waste will be covered by soil at the end of each day, and by a thicker layer of topsoil at the end of each year, when one cell will be closed and another will begin.

167. Excavated 52.30 M3 soil of the new trench adjacent to the active trench will be used for daily, intermediate, and final soil cover. As far as possible, permeable and porous sand types will be used for daily cover to ensure easy spreading and compaction of the solid wastes, stabilize the landfill waste layers as well as not hindering the waste decomposition process. Porous cover soil is not suitable for preventing bad odours from dispersing, Therefore when such types of soils are used, the cover layers shall be made thins as possible so as to prevent the soil from becoming anaerobic. For immediate soil cover, clayey soil is suitable to prevent gases from dispersing or rainwater from seeping into the waste layers. However, if the area is to be used as a foundation for roads, then crusher stones are recommended as covering materials. The final soil cover shall be resistant to corrosion by rainwater, low permeability and suitable for plants.

168. The greatest physical impacts from the operating system will occur at the landfill, where decomposing waste will rise to an eventual height of up to 4 m above ground level, which will greatly alter the appearance and topography of the site.

169. **Leachate Control:** The landfill design includes measures to collect leachate and prevent pollution of surface and groundwater; the collected liquid will be re-circulated on the dumping site in the form of spraying and irrigation for the greenbelt.

170. **Dust Control:** On-site dust will be controlled by use of water truck (include in budget). Water will be used for dust control only in those areas where no potential for creating leachate exists (such as access roads located outside the refuse filling area). In addition to watering, local government will use the following methods to control dust:

(i) Placement of daily, intermediate and final cover over the waste routinely.
(ii) The main access road to the active landfill modules is paved over native ground.

(iii) Continuous attention is given to proper maintenance of haul roads.
(iv) Water spray or dust palliative will be applied on soil-covered work areas when conditions may result in fugitive dust.
(v) Planting and maintenance of vegetation on closed fill slopes.

171. Specific dust control measures may be implemented within the active landfill area, if necessary. The options will be:

(i) Dust control within the Landfill Footprint (Active Areas) – temporary access roads within the landfill footprint will be watered, as required, to prevent dust problems.
(ii) Dust control outside landfill footprint – permanent concrete or asphalt and gravel or rock-surfaced roads outside the landfill footprint will be watered periodically to mitigate dust. Soil surfaced roads will require more frequent watering.
(iii) Using Leachate for Dust Control – leachate may be used for dust control depending on its concentration. However, leachate will only be used on daily cover or waste within the landfill footprint.

172. **Litter Control**: If waste is collected regularly from houses, litter bins and the storage bins are emptied daily as intended, there should be no direct impacts on the physical environment. Aizawl municipal council will attempt to minimize windblown or dropped materials on-site. The sites will be checked daily for waste that has been blown or fallen from the collection vehicles. Ditches will be kept clear of litter material to maintain hydraulic properties and will be checked weekly unless the site conditions require a greater frequency. Waste collectors will be instructed to cover loads and vehicles with improper covered loads will be reprimanded. Public roads adjacent to the site will be checked daily for waste materials. The right-of-way within two (2) kilometres in either direction will be checked periodically for windblown or spilled materials.

173. **Vector Control**: The main concern is that if vectors are allowed to thrive in landfills, diseases could pose a threat to human health and/or the environment. Poorly-managed landfills can cause negative ecological impacts by allowing the development of large colonies of scavenging birds, rodents and other vermin, which can then be a nuisance and health hazard in nearby communities, and can reach pest levels on surrounding agricultural land. Aizawl municipal council will operate the landfill in a manner that it will not be a haven for rodents and insects. Special attention will be given to maintenance of daily, intermediate, and final soil cover as well as to proper drainage. In the event that rodent, bird and/or insect activity becomes apparent, supplemental vector control measures may need to be initiated.

(i) **Rodent control**. Rats and mice are problems at many landfills. Rats and mice will be controlled by placement of daily cover. An important step is to get rid of waste piles and places where these vectors can live. Setting traps is also a common way to determine if rats and mice are present at the landfill. By tracking the results of the trapping of, one can determine not only if there is a problem with rats and/or mice, but also whether or not the problem is increasing. If determined that the landfill has a problem with rats and mice, mitigation measures will include (a) using grain poison however care must be taken that other animals (such as protected birds) do not ingest it; (b) using cover soil to eliminate much food source; (c) using traps to reduce the number of rats and mice; and (d) removing or covering exposed refuse.
(ii) **Fly control.** Flies are problem for landfill that receive large amount of putrescible wastes, especially if the waste is not completely covered at the end of each working day. The simplest way to avoid having a fly problem at the landfill is to cover all garbage at the end of each working day.

174. **Odor Control**: Odors at landfill are often results of refuse that is being unloaded or is improperly covered. During landfill operation, daily and intermediate cover placement will help control odours. When highly odorous loads are received, they will be covered immediately with soil. To control odors from in-place refuse (from decomposition of old waste), integrity of soil cover material over all existing wastes will be maintained. Refuse compaction will also help control odour. Planting trees, shrubs, flowers, and other vegetation around the perimeter of the landfill will help mitigate some of the landfill odours. Aizawl municipal council is responsible for maintenance and management for odor control facilities including green belt and aesthetic plantation. For odour control in vermi composting facilities sufficient air holes for o2 supply and humidity control will be provided.

175. The design also includes measures to maintain an orderly appearance at the site and to prevent the liberation of excessive odours, as deposited waste will be covered with soil after compaction at the end of each day; and when a cell is closed at the end of each year, a thicker layer of topsoil will be applied to effectively seal the completed area. Simple tube vents will be inserted into the material to allow the escape of methane and other gases produced by the decomposition process, and equipment will be provided for automatic monitoring of such gases.

176. **Noise Abatement:** The noise associated with the operation of the landfill will be decreased by fitting all equipment with sound dampening devices (such as mufflers) and keeping the vehicles in good working conditions. Maintenance of the vehicles and equipment will be conducted periodically in accordance with the Landfill O&M Manual.

177. **Periodic Routine Inspections:** AMC will maintain the individual facilities and the waste management system and ensure that it will be kept in good working order in accordance to the Landfill O&M Manual. AMC will also ensure that no waste will accumulate in streets and on open ground.

178. **Traffic Control:** Operating the waste management system will impact traffic and transportation as there will be more vehicles on the roads in and around the town, collecting and transporting the storage bins and transferring waste to the landfill. This will be mitigated by conducting these collections early in the day (when traffic is light) as much as possible.

179. **Ecology:** There can be small ecological gains as well as improvements in the appearance of such sites if trees are planted on and around completed waste cells so this should be done. Given the sandy soil and high rainfall of the area such planting may need to be supported by the application of fertilizer from the composting plant and the use of an artificial watering regime.

180. **Economic Development:** Business and small industry in the town should operate more efficiently if their waste is removed speedily and efficiently, so there should be small economic gains once the system is in place. The main economic benefit will be obtained by the companies that are involved in operating the waste management system, either in partnership with the Municipality via PSP schemes or through direct employment.

181. **Social and Cultural Resources:** The main beneficiaries of the improved system of waste management will be the citizens of the town, whose general environment, and in some cases living conditions, will be improved considerably. The unsightly mounds of garbage should no longer be evident in the town, and the attendant appearance, smell and public health risk should be removed.

182. There will also be socio-economic benefits for people who are able to gain employment with companies involved in operating the system, or with the Municipality, who will need to increase their manpower.

183. **Occupational Health and Safety:** It is important that employees understand the risks they may be exposed to. AMC will at least tell them: (i) the likely exposure and the risks; (ii) what AMC is doing to control risks and exposures; (iii) where and how people can obtain protection; (iv) how to report defects in protection and control equipment; and (v) what they shall do to minimize the risk, such as the proper way to use protection and other control equipment, how to look after it and store it, and where to use it. This information will be given in a way the employee can be expected to understand (for example special arrangements might need to be made if the employee does not understand English or cannot read).

184. **Community Health and Safety:** Vehicle movements cause deaths and some of the most serious accidents. Vehicles will be fitted with highly audible reversing alarms and mirrors. These will be checked at least daily and maintained in good working order. Only authorized and competent workers will be allowed to operate the vehicles. Collection routes will be planned to avoid times of high-pedestrian activities. AMC will liaise with communities to position collection points in safe positions and/or collect at quiet times. AMC will also identify high-risk areas on route cards/maps and access pedestrianized areas such as markets and schools during quiet hours.

E. Cumulative Impact Assessment

185. The cumulative impact assessment (CIA) examined the interaction between the subproject's residual effects (i.e., those effects that remain after mitigation measures have been applied) and those associated with other past, existing and reasonably foreseeable future projects or activities. Since the proposed subproject is converting the existing unsanitary dumpsite into a sanitary, scientific landfill compliant with the government's MSWMHR, 2000, the cumulative impacts are positive and large in both spatial and temporal terms. The subproject's potential cumulative effects were considered with respect to Valued Components (VCs) in the categories of environmental, socio-economic, and heritage resources in four areas:

(i) Of any potential residual project effects that may occur incrementally over time;
(ii) Consideration of other known relevant projects or activities within the specified study area boundaries, even if not directly related to the subproject;
(iii) Potential overlapping impacts that may occur due to other developments, even if not directly related to the proposed project; and
(iv) Future developments that is reasonably foreseeable and sufficiently certain to proceed.

186. In addition, the CIA considered the scope or influence of the subproject. Two boundaries, spatial and temporal5, were used.

187. The subproject IEE has identified the VCs as air quality, water (surface and groundwater) quality, noise, geophysical (hydrogeological), traffic management, social-economic and socio-community, and human health. There are no foreseeable projects that will

[5] Spatial boundary refers to the area immediately surrounding the subproject location; while the temporal area considers the potential cumulative effects associated with subproject construction, and operation and maintenance, and those associated with other past, existing and reasonably foreseeable projects in the vicinity of the subproject.

overlap with the subproject. The spatial and temporal boundary of the subproject is the whole GAPA.

188. Air quality effects will occur during construction and operation. Consequently, although emissions of common air contaminants (CAC) and fugitive dust may be elevated in proximity to active work sites, this impact will be short-term and localized to the immediate vicinity of the alignment. Greenhouse Gas (GHG) emissions may increase as a result of project activities (i.e., vehicle and equipment operation, concrete production, disposal of excavated material, landfilling of residual wastes). Given the subproject's relatively minor contribution to CAC and GHG emissions during construction, the overall significance rating of both these potential residual effects is considered to be negligible during construction.

189. The incremental GHG emissions from this subproject will have a cumulatively considerable contribution to the State and National GHG emission reduction goals, although design characteristics and mitigation measures are intended to reduce the overall impact. During operation, the landfill can be brought under the preview of Clean Development Mechanism (CDM) project where the investment incurred for the technological installation for GHG emission mitigation can be recovered by the transaction cost gained by trading-off the CER. Further actions to be taken for such purpose are as follows:

(i) Documentation for applying the CDM project in the proposed landfill (to be considered during implementation).

190. Land use/traffic management concerns will occur spatially during construction. During construction, site-specific mitigation measures will be implemented to address temporary disruptions to land use and access in the vicinity of the alignment such as road and sidewalk closures, traffic delays and detours, parking modifications, and increased volumes of construction–related traffic. There should be improved traffic movement along the road once construction is completed. Since the subproject will be built at the existing dumpsite, it will not conflict with existing or planned land use. The city will become much cleaner over time with improved management which can be considered a long-term cumulative benefit of the subproject.

191. Implementation of the subproject will have negligible effect on the aesthetic character of the local area because it will involve the development of a vacant lot in near the existing dumpsite. By incorporating standard mitigation measures and local regulatory requirements, the subproject will positively change the aesthetic character of the area by providing new engineered and planned structures.

192. No adverse residual effects to human health will occur as a result of subproject construction or operation. While exposure to elevated noise levels and fugitive dust and CAC emissions will occur in proximity to subproject work sites during construction, due to their short-term, localized nature, these effects are expected to be minor and insignificant with no measurable effects on human health. The subproject operations will benefit the general public by contributing to the long-term improvement of solid waste management and community liveability in Aizawl.

V. PUBLIC CONSULTATION AND INFORMATION DISCLOSURE

A. Project Stakeholders

193. Three levels of stakeholder consultations were undertaken in Aizawl. The primary stakeholder group or civil society, comprising of community, poor, women and environmental groups and NGOs were consulted to get information on present service levels and quality, and priority for improvements. The secondary stakeholder group comprising of elected representatives at both the state and local level and officials and staff of concerned government departments, the public sector providers of urban services, were consulted for policy, technical, financial, qualitative and quantitative inputs.

194. The social, gender and environmental groups consulted in Aizawl were Centre for Science and Environment, Science Teachers Association of Mizoram and Clean Mizoram Society. The Community Building Organizations (CBOs) consulted in Aizawl included the Young Men's Christian Association (YMA), the Mizo Hmeichhia Inzawmkhawm Pawl (MHIP) which is the women's Organization and the old People's Association, MUP. Some of the village councils are involved in providing the services related to solid waste management.

195. Consultation with project stakeholders has been an integral part of the project and a continuous process dovetailed into the project as required and feasible throughout the project duration. A range of consultation tools such as workshops, focus group discussions (FGDs), formal and semi structured interviews, presentations, information brochures, informal discussions, mapping, have been used extensively as part of consultations activities. A parallel exercise of consultation in the form of socio economic survey has been conducted extensively in Aizawl with every households being surveyed for project related information.

B. Public Consultations

196. Various Numbers of consultations has been held for this project. However, a total of 11 consultation meetings have been held in Aizawl during the preparation of this IEE (January 2014 to September 2014). Details are summarized in Table 17.

Table 17: Records of Public Consultations and Information Disclosure

No	Type of Consultation	Stakeholder	LC Area	Venue	No of participants	Date	Time	Duration
COMMUNITY								
1	Focus group Discussion (FGD)	Community	Govt. complex Luangmual	V.C Hall	28	28.4.2014	19:00	120 mins
2	FGD	Sanitary inspector from AMC and UD&PAD	Aizawl	SIPMIU office	10	17.6.2014	13:00	90 mins
3	FGD	LC, YMA, MHIP & MUP members	Laipuitlang	Residence of LC Chairman	15	30.6.2014	11:00	120 mins
4	FGD	Community	College Veng	YMA hall	42	10.7.2014	19:00	180 mins
5	FGD	Community	Nursery Veng	V.C Hall	44	17.7.2014	19:30	180 mins
6	FGD	Community	Chawnpui	Chawnpui	71	31.07.2014	19:30	180

No	Type of Consultation	Stakeholder	LC Area	Venue	No of participants	Date	Time	Duration
				Sport Centre				mins
7	FGD	Community	Kanan	Kanan multipurpose Hall	150	1.08.2014	19:30	180 mins
8	FGD	Sanitation workers of the area	Kanan	Residence of LC Chairman	16	5.09.2014	19:30	60 mins
9	FGD	Sanitation workers of the area	Nursery	V.C Hall	18	6.09.2014	10:00	60 mins
10	FGD	Sanitation workers of the area	Chawnpui	MHIP house	16	11.09.2014	15:00	60 mins
11	FGD	Sanitation workers of the area	College Veng	Residence of LC Chairman	17	12.09.2014	15:00	60 mins

Date	**Location**	**No. of Participants**	**Type of Participants**	**Topics Discussed**	**Issues Raised**
8Mar2011	Turial	6 M-5,F-1	Local members	About the project and descriptions and the change of method from the currnet dump site. Positive and negative impact of the construction. Local community response towards the project	Local people &community participation in project implementation Smoke from the current dumping site
31 Jan 2013	Zemabawk YMA Hall	30 M-17,F-13	Local Residents of Zemabawk, Local Council and NGOs	The location of proposed project land is under Zemabawk Local Council. Information and discussion was required for obtaining consent. About the project and descriptions and the change of method from the currnet dump site. Positive and negative impact of the Water Supply System construction	Low income household contribution/ participation in project implementation Awareness programs for the community about hygiene Smoke free disposal of waste. Declaration shown in **Annexure 4** (copy shown below)
6 Feb 2015	AMC dump site	33 M-23, F-17	Affected persons (rag pickers)	Closure of AMC dumpsite. Potential positive and negative impacts of the project ADB safeguards policy and entitlements	Livelihood restoration.

197. The primary objective of the North-eastern Region Capital Cities Development Investment Programme (NERCCDIP) for Aizawl is to promote the economic development in the city of Aizawl through expansion of basic services such as water supply, sewerage, sanitation, and solid waste management in the city. The NERCCDIP will also strengthen the service

delivery capacity of the responsibilities of Aizawl state urban agencies, and urban local bodies through management reform, capacity building, and training. As a part of the process of improving solid waste management for the city of Aizawl, and landfill sites will be developed in Tranche 3 of the project. The major factor contributing to this objective is to overcome the present deficit in proper and effective management of sewerage and solid waste in the city of Aizawl. The public consultation meetings have been designed to make people aware of the NERCCDIP, inviting queries from them, and thus arousing interest in people to take part in this program. The SPECIAL OBJECTIVE, other than the general objective, was to assess the people's response about the locations of the sites, the benefits to be derived, and any likely problem they foresee

198. Stakeholders from various levels in Aizawl attended the consultations to discuss project related issues on a common platform with other project. The workshop was held to consolidate the way forward in achieving the goals of the project with the support of key stakeholders and was attended in addition to the Government of Mizoram representatives. The workshop focused on Projects, sustainability issues and environmental and social safeguards, Urban Sector Agenda in the project city. The consultation was held in various localities among the stakeholders and public regarding the importance of waste segregation at source and waste handling. Presentations were made on other issues related to the project as well. Trainings on segregation of wet and dry waste were also given. Handouts, pamphlets, feedback forms etc were also given. They showed keen interest in participation towards a cleaner and hygienic waste handling.

199. English version of the Environmental Assessment and Review Framework (EARF) has been placed in the offices of UD&PAD and SIPMIU. Mizo (local language) versions of the IEE will be provided during workshops to ensure stakeholders understood the objectives, policy, principles, and procedures.

C. Future Consultation and Disclosure

200. UD&PAD extended and expanded the consultation and disclosure process significantly during implementation of NERCCDIP. They have appointed an experienced NGO to handle this key aspect of the program. The NGO continuously (i) conducts a wide range of activities in relation to all subprojects in the city; and (ii) ensures the needs and concerns of stakeholders are registered and are addressed in subproject design (iii) updated IEE per detail design to be submitted to ADB for review and approval.

201. For this subproject, the NGO/Local Village council will in close coordination with SIPMIU and DSMC, a public consultation and disclosure program which is to include the following:

(i) Consultation during detailed design:
- Focus-group discussions with affected persons and other stakeholders (including women's groups, NGOs and CBOs) to hear their views and concerns, so that these can be addressed in subproject design where necessary; and
- Structured consultation meetings with the institutional stakeholders (government bodies and NGOs) to discuss and approve key aspects of the project.

(ii) Consultation during construction:
- Public meetings with affected communities (if any) to discuss and plan work programs and allow issues to be raised and addressed once construction has started; and

- Smaller-scale meetings to discuss and plan construction work with individual communities to reduce disturbance and other impacts, and provide a mechanism through which stakeholders can participate in subproject monitoring and evaluation.

(iii) Project disclosure:

- Public information campaigns (via newspaper, TV and radio) to explain the project to the wider town population and prepare them for disruption they may experience once the construction program is underway;
- Public disclosure meetings at key project stages to inform the public of progress and future plans, and to provide copies of summary documents in local language; and
- Formal disclosure of completed project reports by making copies available at convenient locations in the study towns, informing the public of their availability, and providing a mechanism through which comments can be made.

202. Based on ADB requirements, the following will be posted on ADB website: (i) this IEE, upon receipt; (ii) a new or updated IEE, if prepared, reflecting significant changes in the Project during design or implementation and submitted to ADB for review and approval; (iii) corrective action plan prepared during Project implementation to address unanticipated environmental impacts and to rectify non-compliance to EMP provisions; and (iv) environmental monitoring reports, upon receipt.

VI. GRIEVANCE REDRESS MECHANISM

203. A project-specific grievance redress mechanism (GRM) will be established to receive, evaluate, and facilitate the resolution of APs' concerns, complaints, and grievances related to social and environmental issues of the project. The GRM will aim to provide a time-bound and transparent mechanism to voice and resolve social and environmental concerns linked to the project.

204. A common GRM will be in place for social, environmental, or any other grievances related to the project. Every grievance shall be registered and careful documentation of process with regard to each grievance undertaken, as explained below. The SIPMIU environmental and social safeguards officers will have the overall responsibility for timely grievance redress on environmental and social safeguards issues.

205. Public awareness campaign will be conducted to ensure that awareness on the project and its grievance redress procedures is generated. The SIPMIU environment and social safeguard officers will be assisted by design and supervision management consultant (DSMC) safeguards specialists with information/collateral/awareness material etc. and in conducting project awareness campaigns. The campaign will ensure that the poor, vulnerable and others are made aware of grievance redress procedures and entitlements per project Resettlement Framework, and SIPMIU will ensure that their grievances are addressed.

206. Affected persons will have the flexibility of conveying grievances/suggestions by dropping grievance redress/suggestion forms in complaints/suggestion boxes that have already been installed by SIPMIUs or through telephone hotlines at accessible locations, by e-mail, by post, or by writing in a complaints register in SIPMIU offices. Appendix 9 has the sample grievance registration form. Careful documentation of the name of the complainant, date of receipt of the complaint, address/contact details of the person, location of the problem area, and

how the problem was resolved will be undertaken. SIPMIU safeguard officers will have the overall responsibility for timely grievance redressal on environmental and social safeguards issues and for registration of grievances, related disclosure, and communication with the aggrieved party.

207. **Grievance redress process.** In case of grievances that are immediate and urgent in the perception of the complainant, the contractor and DSMC on-site personnel will provide the most easily accessible or first level of contact for quick resolution of grievances. Contact phone numbers and names of the concerned SIPMIU safeguard officers and contractors will be posted at all construction sites at visible locations. The SIPMIU safeguard officers will be responsible to see through the process of redressal of each grievance.

(i) **1st Level Grievance.** The phone number of the SIPMIU office should be made available at the construction site signboards. The contractors and SIPMIU safeguard officers can immediately resolve on-site in consultation with each other, and will be required to do so within 7 days of receipt of a complaint/grievance.
(ii) **2nd Level Grievance.** All grievances that cannot be redressed within 7 days at field/ward level will be reviewed by the city-level grievance redress committee (GRC) with support from SIPMIU safeguard officers and DSMC environment and resettlement specialists. City-level GRC will attempt to resolve them within 15 days.
(iii) **3rd Level Grievance.** The SIPMIU safeguard officers will refer any unresolved or major issues to the State-level GRC, who with consultation with SIPMIU and city-level GRC will resolve them within 15 days.

208. Despite the project GRM, an aggrieved person shall have access to the country's legal system at any stage, and accessing the country's legal system can run parallel to accessing the GRM and is not dependent on the negative outcome of the GRM.

209. In the event that the established GRM is not in a position to resolve the issue, the affected person also can use the ADB Accountability Mechanism through directly contacting (in writing) the Complaint Receiving Officer (CRO) at ADB headquarters or the ADB India Resident Mission (INRM). The complaint can be submitted in any of the official languages of ADB's developing member countries. The ADB Accountability Mechanism information will be included in the project-relevant information to be distributed to the affected communities, as part of the project GRM.

210. **Recordkeeping.** Records of all grievances received, including contact details of complainant, date the complaint was received, nature of grievance, agreed corrective actions and the date these were effected and final outcome will be kept by SIPMIU. The number of grievances recorded and resolved and the outcomes will be displayed/disclosed in the SIPMIU office, and on the web, as well as reported in the semi-annual environmental monitoring reports to be submitted to ADB.

211. **Periodic review and documentation of lessons learned.** The SIPMIU safeguard officers will periodically review the functioning of the GRM and record information on the effectiveness of the mechanism, especially on the SIPMIU's ability to prevent and address grievances.

212. **Costs.** All costs involved in resolving the complaints (meetings, consultations, communication and reporting/information dissemination) will be borne by the concerned SIPMIU; while costs related to escalated grievances will be met by the EAs. Cost estimates for

grievance redress are included in resettlement cost estimates. The grievance redress process is shown in Figure 19.

Figure 19: NERCCDIP Grievance Redress Mechanism

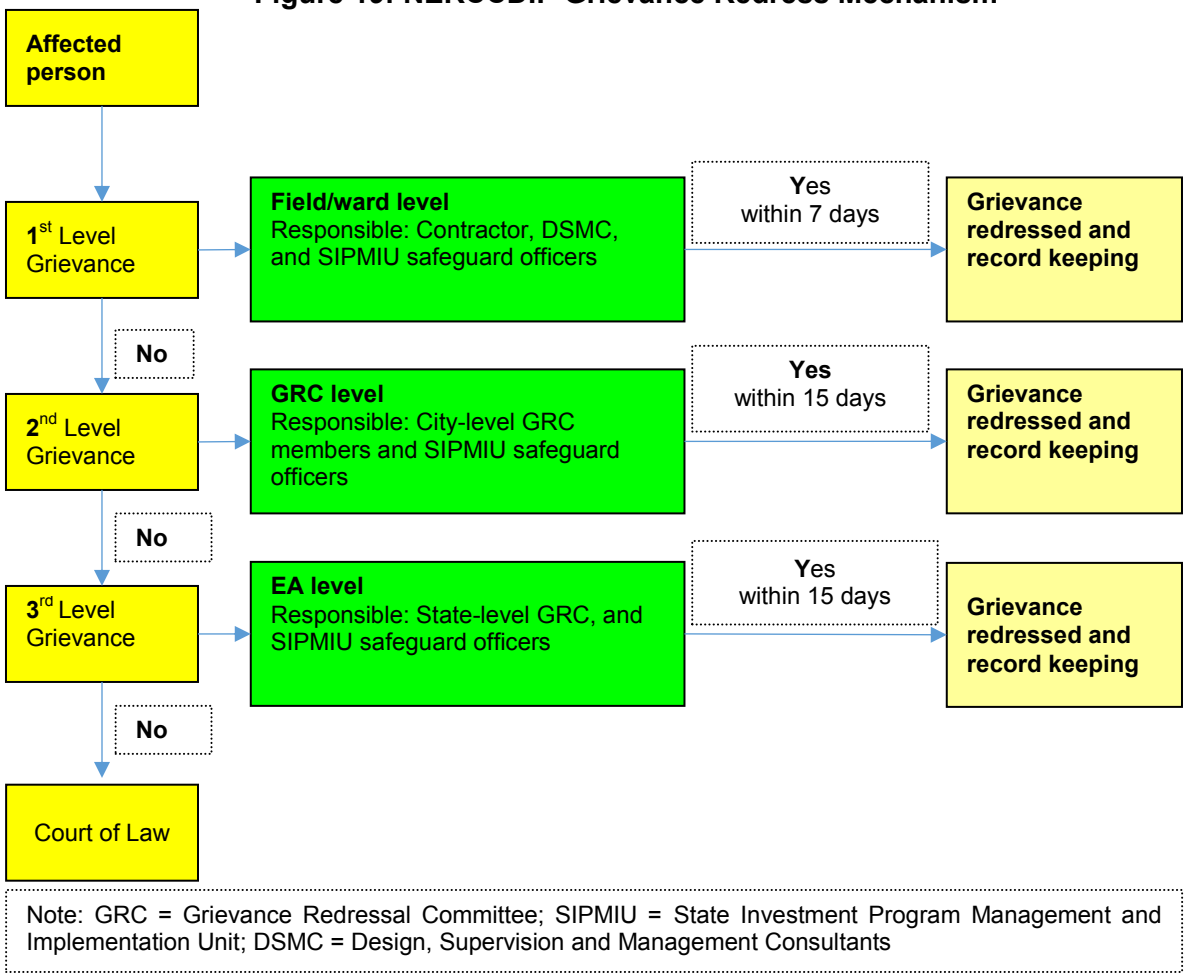


Table No 18: GRC Member for NERCCDIP Aizawl

STATE LEVEL		
1.	Minister, UD&PA Department, Mizoram	Chairman
2.	Deputy Commissioner	Convener
3.	Secretary, UD&PA, Govt. of Mizoram	Member
4.	Secretary, Law and Judicial Department	Member
5.	CEO, Aizawl Municipal Council	Member
6.	Project Director, SIPMIU	Member
CITY LEVEL		
1.	Deputy Commissioner , Aizawl	Chairman
2.	Project Director, SIPMIU	Convener
3.	CEO, Aizawl Municipal Council	Member
4.	Councillor of concern ward	Member
5.	Chairman of concerned Local Council	Member
6.	Chief Engineer, PHED	Member
7.	Chief Engineer, PWD	Member
8.	Director, UD &PA	Member
9.	President Central YMA (NGO)	Member

10.	President, MUP (NGO)	Member
11.	President, Mizoram Consumer Union	Member
12.	President, MHIP (NGO)	Member

VII. ENVIRONMENTAL MANAGEMENT PLAN

A. Implementation Arrangements

213. The Ministry of Urban Development (MOUD) is the national-level executing agency (EA) and the Urban Development Department of Tripura and the Urban Development and Poverty Alleviation Department of Mizoram are the state-level EAs. Each NERCCDIP state has established State-level Investment Program Management and Implementation Units (SIPMIU).

214. The environmental safeguards officer in the SIPMIU will:

(i) confirm existing IEEs/EMPs are updated based on detailed designs and that new IEEs/EMPs are prepared in accordance with the EARF and subproject selection criteria related to safeguards;
(ii) confirm whether IEEs/EMPs are included in bidding documents and civil works contracts;
(iii) provide oversight on environmental management aspects of subprojects and ensure EMPs are implemented by the contractors;
(iv) establish a system to monitor environmental safeguards of the project including monitoring the indicators set out in the monitoring plan of the EMP;
(v) facilitate and confirm overall compliance with all Government rules and regulations regarding site and environmental clearances as well as any other environmental requirements (e.g., No Objection Certificates, Consent for Establishment, Forest Clearance, Consent for Operations, etc.), as relevant; All necessary environmental clearances should be obtained prior to contract awards to avoid delay in physical progress of relevant subprojects;
(vi) supervise and provide guidance to the contractors to properly carry out the environmental monitoring and assessments as per approved IEEs/EMPs;
(vii) review, monitor and evaluate the effectiveness with which the EMPs are implemented, and recommend necessary corrective actions to be taken as necessary;
(viii) consolidate monthly environmental monitoring reports from contractors and submit semi-annual monitoring reports to ADB;
(ix) ensure timely disclosure of final IEEs/EMPs in locations and form and language accessible to the public and local communities; and
(x) address any grievances brought about through the Grievance Redress Mechanism (GRM) in a timely manner; and
(xi) organize an induction course for the contractors covering, including among others, EMP implementation, health and safety, grievance redressal, and community protection.

215. SIPMIU will be assisted by the DSMC, who will design the infrastructure, manage tendering of contracts, and supervise the construction process. The environment sspecialist in the DSMC will, but not limited to:

(i) review environmental guidelines and requirement of GoI, state governments and ADB SPS, 2009, and EARF;
(ii) guide the implementation of future subprojects;

(iii) provide technical support to SIPMIU including review of EARF guidelines for specific type of subprojects and assist in subproject screening, categorization and preparation of required environmental assessment report;
(iv) assist and guide SIPMIU environment officer in environmental management functions including preparing IEEs, updating subproject IEEs as required during subproject implementation, monitoring EMP implementation, preparing semi-annual environmental monitoring reports;
(v) assist SIPMIU environment officer in preparing guidelines and procedure as required in the subproject EMPs;
(vi) provide support and guidance to SIPMIU environment officer in undertaking environmental monitoring;
(vii) facilitate grievance redress at field level;
(viii) assist contractors in implementing corrective actions for non-compliances;
(ix) provide training on environmental safeguards to SIPMIU staff and contractors; and
(x) perform any other task assigned by DSMC team leader, deputy team leader and SIPMIU project director.

216. **Civil works contracts and contractors**. IEEs and EMPs are to be included in bidding and contract documents and verified by the SIPMIUs. The contractor will be required to designate an environmental supervisor/focal person to (i) coordinate with DSMC on updating the IEE/EMP or developing a site-specific EMP based on detailed designs, and (ii) ensure implementation of EMP during civil works. Contractors are to carry out all environmental mitigation and monitoring measures outlined in their contract.

B. Institutional Capacity Development Program for EMP Implementation

217. The DSMC environmental specialist is responsible for trainings on environmental awareness and management in accordance with both ADB and government requirements. Specific modules customized for the available skill set will be devised after assessing the capabilities of the target participants and the requirements of NERCCDIP. Typical modules would be as follows: (i) sensitization; (ii) introduction to environment and environmental considerations in water supply and wastewater projects; (iii) review of IEEs and integration into the project detailed design; (iv) improved coordination within nodal departments; and (v) monitoring and reporting system. The contractors will be required to attend environmental awareness and orientation prior to deployment to work sites. The proposed training project along with the frequency of sessions is presented in Table 19.

Table 19: Proposed Institutional Capacity Building Program

Program	Description	Participant	Form of Training	Duration/ Location	Training Conducting Agency	Source of Funds
Pre-Construction						
Session I						
Module II	Environmental Considerations in Urban Development and Solid Waste Management (SWM) Projects: Environmental components affected	Engineers of PWD, PHED and SWM Division of UD&PAD SIPMIU (Technical Unit) and SIPMIU (Environmental Unit including the	Workshop	½ Working Day	Environmental Specialist of the Design and Supervision Consultants	included in the Project Cost

Program	Description	Participant	Form of Training	Duration/ Location	Training Conducting Agency	Source of Funds
	by urban development and SWM in construction and operation stages Activities causing pollution during construction and operation stages Environmental Management Good Practices in Urban Infrastructure and SWM Projects MSW Handling Rules, 2000 monitoring requirements.	Environmental Officer)				
Module IV	Improved Coordination with other Departments: Overview of NERCCDIP Environmental & Social Impacts Statutory Permissions – Procedural Requirements Co-operation & Coordination with other Departments.	Engineers of PWD, PHED and UDD SIPMIU (Technical Unit) and SIPMIU (Environmental Unit including the Environmental Officer)	Lecture/ Interactive sessions	½ Working Day	Environmental Specialist of the Design and Supervision Consultants	included in the Project Cost
Module V	Special Issues in NERCCDIP Bio-Diversity Assessment & Conservation Geomorphological Assessment and Slope Protection Statutory Permissions – Procedural Requirements Consultation and Counselling	SIPMIU (Technical Unit) and SIPMIU (Environmental Unit including the Environmental Officer)	Lecture	½ Working Day	Environmental Specialist of the Design and Supervision Consultants / PMC Consultant	included in the Project Cost
B. Construction Stage						
Session II						
Module VI	Role during Construction Roles and Responsibilities of officials/ contractors/ consultants towards protection of environment	Engineers of PWD, PHED and SWM Division of UD&PAD SIPMIU (Technical Unit) and SIPMIU (Environmental Unit including the	Lecture/ Interactive sessions	½ Working Day	Environmental Specialist of the Design and Supervision Consultants PMC Consultant	included in the Project Cost

Program	Description	Participant	Form of Training	Duration/ Location	Training Conducting Agency	Source of Funds
	Implementation Arrangements Monitoring mechanisms	Environmental Officer)				
Module VII	Monitoring and Reporting System Monitoring mechanisms MSW Handling Rules, 2000 monitoring requirements.	SIPMIU (Technical Unit) and SIPMIU (Environmental Unit including the Environmental Officer); SWM Division of UD&PAD	Lecture/ Interactive sessions	½ Working Day	Environmental Specialist of the Design and Supervision Consultants	included in the Project Cost

ADB = Asian Development Bank, CEO = Chief Executive Officer, IEE = initial environmental examination, MSW = municipal solid waste, NERCCDIP = North Eastern Region Capital Cities Development Investment Program, PHED = Public Health Engineering Department, PWD = Public Work Department, SIPMIU = State-level Investment Program Management and Implementation Units, SWM = Solid Waste Management, UD&PAD = Urban Development & Poverty Alleviation Department, UDD = Urban Development Department.

C. Environmental Mitigation Plan

1. **Table 8 to 10** shows the potential adverse environmental impacts, proposed mitigation measures, responsible parties, and estimated cost of implementation. This EMP will be included in the bid documents and will be further reviewed and updated during implementation.

D. Environmental Monitoring Program

2. **Table 11 to 13** shows the proposed environmental monitoring program for this subproject. It includes all relevant environmental parameters, location, responsibility of mitigation and monitoring, method of monitoring and frequency of monitoring. Monitoring activities during the detailed engineering design stage will from part of the baseline conditions of the subproject location and will be used as the reference for acceptance of restoration works by the construction contractors.

Table 20: Anticipated Impacts and Mitigation Measures – Pre-construction Environmental Mitigation Plan

Field	Anticipated Impact	Mitigation Measures	Responsible for Mitigation	Monitoring of Mitigation
Statutory Requirements	Non-compliance with National Laws	(i) Environmental Clearance under EIA Notification (ii) Consent to Establish under Air (Prevention and Control of Pollution) Act (iii) Authorization for setting up waste processing and disposal facility from Mizoram State Pollution Control Board (iv) Tree-cutting Permit from the Forest Department	SIPMIU with assistance from DSMC	(i) Environmental Clearance (ii) Consent to Establish (Water) (iii) Consent to Establish (Air) (iv) Authorization for setting up waste processing and disposal facility; (v) Tree-cutting Permit
Site Consideration	Habitation within 500 m from the landfill boundaries	Declaration of "No-Development Buffer Zone" after the landfill location is finalized	SIPMIU & DSMC	"No-Development Buffer Zone" declared
Social and Cultural Resources	Ground disturbance can uncover and damage archaeological and historical remains	(i) Consult UD&PAD to obtain an expert assessment of the archaeological potential of the site; (ii) Consider alternatives if the site is found to be of high risk; (iii) Include state and local archaeological, cultural and historical authorities, and interest groups in consultation forums as project stakeholders so that their expertise can be made available; and (iv) Develop a protocol for use by the construction	SIPMIU & DSMC	Chance Finds Protocol

Field	Anticipated Impact	Mitigation Measures	Responsible for Mitigation	Monitoring of Mitigation
		contractors in conducting any excavation work, to ensure that any chance finds are recognized and measures are taken to ensure they are protected and conserved.		
Construction work camps, hot mix plants, stockpile areas, storage areas, and disposal areas.	Disruption to traffic flow and sensitive receptors	(i) Prioritize areas within or nearest possible vacant space in the subproject location; (ii) If it is deemed necessary to locate elsewhere, consider sites that will not promote instability and result in destruction of property, vegetation, irrigation, and drinking water supply systems; (iii) Do not consider residential areas; (iv) Take extreme care in selecting sites to avoid direct disposal to water body which will inconvenience the community.	SIPMIU and DSMC to determine locations prior to award of construction contracts.	List of selected sites for construction work camps, hot mix plants, stockpile areas, storage areas, and disposal areas.
Sources of Materials	Extraction of materials can disrupt natural land contours and vegetation resulting in accelerated erosion, disturbance in natural drainage patterns, ponding and water logging, and water pollution.	(i)Prioritize sites already permitted by the Mining Department; (ii) If other sites are necessary, inform construction contractor that it is their responsibility to verify the suitability of all material sources and to obtain the approval of	SIPMIU and DSMC to prepare list of approved quarry sites and sources of materials	(i) List of approved quarry sites and sources of materials; (ii) Bid document to include requirement for verification of suitability of sources and permit for additional quarry sites if necessary.

Field	Anticipated Impact	Mitigation Measures	Responsible for Mitigation	Monitoring of Mitigation
		SIPMU and (iii) If additional quarries will be required after construction is started, inform construction contractor to obtain a written approval from SIPMU.		
Landfill Operations Manual	Landfill integrity is not maintained	(i) Prepare Operations and Maintenance (O&M) Manual	SIPMIU & DSMC	(i) O&M Manual
Environmental Monitoring Program	Non-compliance with CPHEEO Manual	(i) conduct one (1) year baseline surveys of groundwater quality, surface water quality, landfill gas, dust, odor, noise, and vegetative cover	DSMC	(i) baseline survey results for one (1) years

CPHEEO = Central Public Health and Environmental Engineering Organization, DSMC = Design Supervision Management Consultant, EIA = Environmental Impact Assessment, O&M = operation and maintenance, SIPMIU = State-level Investment Program Management and Implementation Units, UD&PAD = Urban Development & Poverty Alleviation Department.

Table 21: Anticipated Impacts and Mitigation Measures – Construction Environmental Mitigation Plan

Field	Anticipated Impact	Mitigation Measures	Responsible for Mitigation	Monitoring of Mitigation
Sources of Materials	Extraction of rocks and material may cause ground instability	(i) Use quarry sites and sources permitted by government; (ii) Verify suitability of all material sources and obtain approval of State Investment Program Management & Implementation Unit (SIPMIU); and (iii) Submit to DSMC on a monthly basis documentation of sources of materials.	Construction Contractor	Construction Contractor documentation
Air Quality	Emissions from construction vehicles, equipment, and machinery	(i) Consult with SIPMIU/DSMC on the designated areas for stockpiling of clay, soils,	Construction Contractor	(i) Location of stockpiles; (ii) Complaints from sensitive receptors;

Field	Anticipated Impact	Mitigation Measures	Responsible for Mitigation	Monitoring of Mitigation
	used for excavation and construction resulting to dusts and increase in concentration of vehicle-related pollutants such as carbon monoxide, sulfur oxides, particulate matter, nitrous oxides, and hydrocarbons)	gravel, and other construction materials; (iii) Damp down exposed soil and any stockpiled on site by spraying with water when necessary during dry weather; (iv) Bring materials (aggregates) as and when required; (v) Use tarpaulins to cover sand and other loose material when transported by vehicles; (vi) Fit all heavy equipment and machinery with air pollution control devices which are operating correctly; and (vii) Clean wheels and undercarriage of vehicles prior to leaving construction site.		(iii) Heavy equipment and machinery with air pollution control devices; (iv)Ambient air for respirable particulate matter (RPM) and suspended particulate matter (SPM); (v) Vehicular emissions such as sulphur dioxide (SO2), nitrous oxides (NOx), carbon monoxide (CO), and hydrocarbons
Surface water quality	Mobilization of settled silt materials, run-off from stockpiled materials, and chemical contamination from fuels and lubricants during construction works can contaminate nearby surface water quality.	(i) Avoid stockpiling of earth fill especially during the monsoon season unless covered by tarpaulins or plastic sheets; (ii) Prioritize re-use of excess spoils and materials in the construction works. If spoils will be disposed, consult with SIPMIU/DSMC on designated disposal areas; (iii) Install temporary silt traps or sedimentation basins along the drainage leading to the water bodies; (iv) Place storage areas for fuels and lubricants away from any drainage leading to water bodies; (v) Dispose any wastes generated by construction activities in designated sites; and	Construction Contractor	(i) Areas for stockpiles, storage of fuels and lubricants and waste materials; (ii) Number of silt traps installed along drainages leading to water bodies; (iii) Records of surface water quality inspection; (iv) Effectiveness of water management measures; (v) For inland water: suspended solids, oil and grease, biological oxygen demand (BOD), and coliforms.

Field	Anticipated Impact	Mitigation Measures	Responsible for Mitigation	Monitoring of Mitigation
		(vi) Conduct surface quality inspection according to the Environmental Management Plan (EMP).		
Noise Levels	Increase in noise level due to earth-moving and excavation equipment, and the transportation of equipment, materials, and people	(i) Plan activities in consultation with SIPMIU/DSMC so that activities with the greatest potential to generate noise are conducted during periods of the day which will result in least disturbance; (ii) Provide prior information to the local public about the work schedule; (iii) Require horns not be used unless it is necessary to warn other road users or animals of the vehicle's approach; (iv) Ensure that there are no old and sensitive buildings that may come under risk due to the use of pneumatic drills; if there is risk, cut the rocks manually by chiselling; and Minimize noise from construction equipment by using vehicle silencers, fitting jackhammers with noise-reducing mufflers, and portable street barriers the sound impact to surrounding sensitive receptor.	Construction Contractor	(i) Complaints from sensitive receptors; (ii) Use of silencers in noise-producing equipment and sound barriers; (iii) Equivalent day and night time noise levels
Landscape and Aesthetics	Solid wastes as well as excess construction materials	(i) Prepare and implement Waste Management Plan; (ii) Avoid stockpiling of excess excavated soils; (iii) Avoid disposal of any debris and waste soils in the forest	Construction Contractor	(i) Waste Management Plan; (ii) Complaints from sensitive receptors;

Field	Anticipated Impact	Mitigation Measures	Responsible for Mitigation	Monitoring of Mitigation
		areas and in or near water bodies/rivers; (iv) Coordinate with UD&PAD for beneficial uses of excess excavated soils or immediately dispose to designated areas; (v) Recover wood, metal, used oil, and lubricants and reuse or remove from the sites; (vi) Manage solid waste according to the following preference hierarchy: reuse, recycling and disposal to designated areas; (vii) Remove all wreckage, rubbish, or temporary structures which are no longer required; and (viii) Request SIPMIU/DSMC to report in writing that the necessary environmental restoration work has been adequately performed before acceptance of work.		(iii) SIPMIU/DSMC to report in writing that the necessary environmental restoration work has been adequately performed before acceptance of work.
Accessibility	Traffic problems and conflicts near project locations and haul road	(i) Conduct work during light traffic; (iii) movement; (v) Do not close the road completely, ensure that work is conducted onto edge of the road; allow traffic to move on one line; (vi) In unavoidable circumstances of road closure, provide alternative routes, and ensure that public is informed about such traffic diversions; (vii) In case of closure of main roads, provide information to the public through media – daily news papers and local cable television	Construction Contractor	(i) Traffic Management Plan; (ii) Complaints from sensitive receptors; (iii) Number of signages placed at subproject location.

Field	Anticipated Impact	Mitigation Measures	Responsible for Mitigation	Monitoring of Mitigation
		(TV) services, about the need and schedule of road closure, and alternative routes; (viii) At all work sites public information/caution boards shall be provided – information shall inter-alia include: project name, cost and schedule; executing agency and contractor details; nature and schedule of work at that road/locality; traffic diversion details, if any; entry restriction information; competent official's name and contact for public complaints.		
Socio-Economic – Income.	Impede the access of residents and customers to nearby shops	(i) Leave space for access between mounds of excavated soil; (ii) Provide wooden planks/footbridges for pedestrians and metal sheets for vehicles to allow access across trenches to premises where required; (iii) Consult affected businesspeople to inform them in advance when work will occur; (iv) Address livelihood issues; implement the Resettlement Plan to address these issues; (v) Provide prior public information about the work schedule in particular locality and the traffic diversions/changes in any – information shall disseminated through local papers and cable television services; (vi) Provide sign/caution/warning boards at work site indicating work schedule	Construction Contractor	(i) Complaints from sensitive receptors; (ii) Number of walkways, signages, and metal sheets placed at subproject location.

Field	Anticipated Impact	Mitigation Measures	Responsible for Mitigation	Monitoring of Mitigation
		and traffic information; prevent public entry into work sites through barricading and security; and (vii) Provide sign boards for pedestrians to inform nature and duration of construction works and contact numbers for concerns/complaints.		
Socio-Economic - Employment	Generation of contractual employment and increase in local revenue	(i) Employ at least 50% of the labour force, or to the maximum extent, local persons within the 2-km immediate area if manpower is available; (ii) Encourage women labour with equal amount of pay as men (iii) Secure construction materials from local market.	Construction Contractor	(i) Employment records; (ii) records of sources of materials
Occupational Health and Safety	Occupational hazards which can arise during work	(i) Develop and implement site-specific Health and Safety (H&S) Plan which will include measures such as: (a) excluding public from the site; (b) ensuring all workers are provided with and use Personal Protective Equipment; (c) H&S Training for all site personnel; (d) documented procedures to be followed for all site activities; and (e) documentation of work-related accidents; (ii) Ensure that qualified first-aid can be provided at all times. Equipped first-aid stations shall be easily accessible throughout the site; (iii) Provide medical insurance coverage for workers; (iv) Secure all installations from unauthorized intrusion and accident	Construction Contractor	(i) Site-specific Health and Safety (H&S) Plan; (ii) Equipped first-aid stations; (iii) Medical insurance coverage for workers; (iv) Number of accidents; (v) Supplies of potable drinking water; (vi) Clean eating areas where workers are not exposed to hazardous or noxious substances; (vii) record of H and S orientation trainings (viii) personal protective equipments; (ix) % of moving equipment outfitted with audible back-up alarms; (xi) sign boards for

Field	Anticipated Impact	Mitigation Measures	Responsible for Mitigation	Monitoring of Mitigation
		risks; (v) Provide supplies of potable drinking water; (vi) Provide clean eating areas where workers are not exposed to hazardous or noxious substances; (vii) Provide H&S orientation training to all new workers to ensure that they are apprised of the basic site rules of work at the site, personal protective protection, and preventing injuring to fellow workers; (viii) Provide visitor orientation if visitors to the site can gain access to areas where hazardous conditions or substances may be present. Ensure also that visitor/s do not enter hazard areas unescorted; (ix) Ensure the visibility of workers through their use of high visibility vests when working in or walking through heavy equipment operating areas; (x) Ensure moving equipment is outfitted with audible back-up alarms; (xi) Mark and provide sign boards for hazardous areas such as energized electrical devices and lines, service rooms housing high voltage equipment, and areas for storage and disposal. Signage shall be in accordance with international standards and be well known to, and easily understood by workers, visitors, and the general public as		hazardous areas such as energized electrical devices and lines, service rooms housing high voltage equipment, and areas for storage and disposal.

Field	Anticipated Impact	Mitigation Measures	Responsible for Mitigation	Monitoring of Mitigation
		appropriate; and (xii) Disallow worker exposure to noise level greater than 85 dBA for a duration of more than 8 hours per day without hearing protection. The use of hearing protection shall be enforced actively.		
Community Health and Safety.	Traffic accidents and vehicle collision with pedestrians during material and waste transportation	The construction contractor will be required to: (i) Plan routes to avoid times of peak-pedestrian activities. (ii) Liaise with SIPMIU/DSMC in identifying risk areas on route cards/maps. (iii) Maintain regularly the vehicles and use of manufacturer-approved parts to minimize potentially serious accidents caused by equipment malfunction or premature failure. (iv) Provide road signs and flag persons to warn of dangerous conditions, in case of location near the road.	Construction Contractor	(i) Traffic Management Plan; (ii) Complaints from sensitive receptors
Quarry Sites and Borrow Pits	Extraction of clay, soils, stones, aggregates, and loose materials other than stones can cause disruption of natural land contours and vegetation resulting in accelerated erosion, landslides, disturbance in natural drainage patterns, sedimentation/siltation of surface waters, and water pollution.	(i) Verify suitability of all material sources and obtain approval of DSMC; (ii) Prioritize government-approved quarries and borrow pits; (iii) Obtain approval of DSMC if new quarries and borrow sites are necessary; (iv) Obtain approval of DSMC if extracting rocks, gravel, and sand from small rivers or streams is necessary. The extraction points shall be spread out along the length of the river to minimize disruption in	Construction contractor	(i) List of approved quarry sites and borrow pits; (ii) SIPMIU/DSMC report in writing that all necessary environmental restoration work has been adequately performed before acceptance of work.

Field	Anticipated Impact	Mitigation Measures	Responsible for Mitigation	Monitoring of Mitigation
		river flow and to prevent instability to embankments. Local residents and water users shall be consulted to ensure that irrigation intakes, bunds, and local fishing are not adversely impacted; and (v) Request DSMC to report in writing that the necessary environmental restoration work has been adequately performed before acceptance of work.		
Work Camps	Temporary air and noise pollution from machine operation, water pollution from storage and use of fuels, oils, solvents, and lubricants	(i) Consult with SIPMIU/DSMC before locating project offices, sheds, and construction plants; (ii) Minimize removal of vegetation and disallow cutting of trees; (iii) Provide water and sanitation facilities for employees; (iv) Prohibit employees from poaching wildlife and cutting of trees for firewood; (v) Train employees in the storage and handling of materials which can potentially cause soil contamination; (vi) Recover used oil and lubricants and reuse or remove from the site; (vii) Manage solid waste according to the following preference hierarchy: reuse, recycling and disposal to designated areas; (viii) Remove all wreckage, rubbish, or temporary structures which are no longer required; and	Construction Contractor	(i) Complaints from sensitive receptors; (ii) Water and sanitation facilities for employees; and (iii) SIPMIU/DSMC report in writing that the camp has been vacated and restored to pre-project conditions

Field	Anticipated Impact	Mitigation Measures	Responsible for Mitigation	Monitoring of Mitigation
		(ix) Request SIPMIU/DSMC to report in writing that the camp has been vacated and restored to pre-project conditions before acceptance of work.		
Social and Cultural Resources – Chance Finds	Risk of archaeological chance finds	(i) Strictly follow the protocol for chance finds in any excavation work; (ii) Request SIPMIU/DSMC or any authorized person with archaeological/historical field training to observe excavation if deemed necessary by local authorities; (iii) Stop work immediately to allow further investigation if any finds are suspected; and (iv) Inform SIPMIU/DSMC if a find is suspected, and take any action they require ensuring its removal or protection in situ.	Construction Contractor	Records of chance finds

DSMC = Design Supervision Management Consultant, H&S = health and safety, RPM = respirable particulate matter, SIPMIU = State-level Investment Program Management and Implementation Units, SPM = suspended particulate matter, UD&PAD = Urban Development & Poverty Alleviation Department.

Table 22: Anticipated Impacts and Mitigation Measures – Operation and Maintenance Environmental Mitigation Plan

Field	Anticipated Impact	Mitigation Measures	Responsible for Mitigation	Monitoring of Mitigation
Leachate Control	surface, groundwater contamination	Re-circulate leachate to the active parts of the landfill	AMC and O&M Contractors	All leachate recirculated
Dust Control	increased PM10 level	(i) Placement of daily, intermediate, and final cover over the waste routinely; (ii) The main access road to the active landfill modules is paved over native ground; (iii) Continuous attention is given to proper maintenance of haul roads;	AMC and O&M Contractors	(i) Records available

Field	Anticipated Impact	Mitigation Measures	Responsible for Mitigation	Monitoring of Mitigation
		(iv) Water spray or dust palliative will be applied on soil-covered work areas when conditions may result in fugitive dust; and (v) Planting and maintenance of vegetation on closed fill slopes.		
Dust Control – Specific	increased PM10 level	(i) Dust control within the Landfill Footprint (Active Areas) – temporary access roads within the landfill footprint will be watered, as required, to prevent dust problems; (ii) Dust control outside landfill footprint – permanent concrete or asphalt and gravel or rock-surfaced roads outside the landfill footprint will be watered periodically to mitigate dust. Soil surfaced roads will require more frequent watering; and (iii) Using Leachate for Dust Control – leachate may be used for dust control depending on its concentration. However, leachate will only be used on daily cover or waste within the landfill footprint. This option will be considered only for leachate meets acceptable level for BOD/COD (following CPHEEO discharge standards) and odor removed.	AMC and O&M Contractors	(i) Records available
Litter Control	clogging of drains, unsightly environment	(i) Minimize windblown or dropped materials on-site; (ii) Daily check for waste that has been blown or fallen from the collection vehicles; (iii) Clear drains of litter material;	AMC and O&M Contractors	(i) Records available

Field	Anticipated Impact	Mitigation Measures	Responsible for Mitigation	Monitoring of Mitigation
		(iv) Instruct waste collectors to cover loads and vehicles; (v) Reprimand waste collectors with uncovered loads		
Vector control	threat to human health and/or the environment	(i) Develop Rodent and Fly Control Plan	AMC and O&M Contractors	Rodents and Flies Control Plan included in O&M Manual
Odour Control	nuisance to sensitive receptors	(i) Cover daily and immediately waste materials with soil; (ii) Maintain integrity of soil cove r material of covered wastes; (iii) Plant trees, shrubs, flowers, and other vegetation (iv) Hose each bin once it is emptied; (v) Ensure that residual waste is not left in bins and allowed to decompose for a long period of time	AMC and O&M Contractors	(i) Odour Control Plan included in O&M Manual; (ii) complaints from sensitive receptors
Noise Abatement	nuisance to sensitive receptors	(i) Fit all equipment with sound dampening devices (such as mufflers); (ii) Keep vehicles in good working conditions; (iii) Maintain vehicles and equipment periodically	AMC and O&M Contractors	(i) Noise Abatement Plan included in O&M Manual; (ii) complaints from sensitive receptors; (iii) Records of Periodic Maintenance available
Occupational Health and Safety	Adverse impacts on the appearance of surrounding environment and exposure of workers to hazardous debris	UD&PAD will at least tell them: (i) The likely exposure and the risks; (ii) What UD&PAD is doing to control risks and exposures; (iii) Where and how people can obtain protection; (iv) How to report defects in protection and control equipment; and (v) What they shall do to	AMC and O&M Contractors	(i) Records of training available; (ii) H&S Plan included in O&MH&S

Field	Anticipated Impact	Mitigation Measures	Responsible for Mitigation	Monitoring of Mitigation
		minimize the risk, such as the proper way to use protection and other control equipment, how to look after it and store it, and where to use it. This information will be given in a way the employee can be expected to understand (for example special arrangements might need to be made if the employee does not understand English or cannot read).		
Community Health and Safety	Vehicle movements cause deaths and some of the most serious accidents.	(i) Fit vehicles with highly audible reversing alarms and mirrors and check at least daily and maintained in good working order. (ii) Allow only authorized and competent workers to operate the vehicles; (iii) Plan collection routes to avoid times of high-pedestrian activities. (iv) Liaise with communities to position collection points in safe positions and/or collect at quiet times; (v) Identify high-risk areas on route cards/maps and access pedestrianized areas such as business areas during quiet hours.	AMC and O&M Contractors	(i) Records available

H&S = health and safety, O&M = operation and maintenance, UD&PAD = Urban Development & Poverty Alleviation Department.

Table 23: Pre-construction Environmental Monitoring Program

Field	Location	Responsible for Mitigation	Monitoring of Mitigation	Method of Monitoring	Indicators/ Standards	Frequency	Responsible for Monitoring

Field	Location	Responsible for Mitigation	Monitoring of Mitigation	Method of Monitoring	Indicators/ Standards	Frequency	Responsible for Monitoring
Baseline Environmental Condition – Groundwater Quality	Subproject location	DSMC	minimum of 3 samples from each aquifer analysed in monthly basis for drinking water quality parameters	Groundwater sample collection and analyses by in-house laboratory or accredited 3rd party laboratory	Government of India Drinking Water Quality Standards	monthly for one year prior to start of construction work	SIPMIU
Baseline Environmental Condition – Surface Water Quality	Subproject location; and Upstream and Downstream of landfill site	DSMC	minimum of 3 samples from a stream/storm water drain analysed on a monthly basis and for parameters relevant for wastewater drains	Surface water sample collection and analyses by in-house laboratory or accredited 3rd party laboratory	GoI Surface Water Quality Standards (wastewater drains)	monthly for one year prior to start of construction work	SIPMIU
Baseline Environmental Condition – Landfill Gas	Subproject location	DSMC	sampling and analysis for methane, hydrogen sulphide and other gases on a monthly basis	Gas sample collection and analyses by in-house laboratory or accredited 3rd party laboratory	GOI National Ambient Air Quality Standards	monthly for one year prior to start of construction work	SIPMIU
Baseline Environmental Condition – Dust	Subproject location	DSMC	particulate matter less than 10 microns (PM10) monitoring on a monthly basis, specifically at noon, during hot, dry and windy days	Air sample collection and analyses by in-house laboratory or accredited 3rd party laboratory	GOI National Ambient Air Quality Standards	monthly for one year prior to start of construction work	SIPMIU
Baseline Environmental	Subproject location	DSMC	monthly analysis at the site and at	Noise meter reading by in-	GoI National Ambient Noise	monthly for one year prior	SIPMIU

Field	Location	Responsible for Mitigation	Monitoring of Mitigation	Method of Monitoring	Indicators/ Standards	Frequency	Responsible for Monitoring
Condition – Noise			200-m intervals from the landfill boundary to the nearest inhabited zone	house laboratory or accredited 3rd party laboratory	Quality Standards	to start of construction work	
Baseline Environmental Condition – Vegetative Cover	Subproject location	DSMC	Vegetative mapping on a seasonal basis	Survey and mapping	No standards, values will be used as baseline	seasonal basis for one year prior to start of construction work	SIPMIU
Environmental Clearances	As per site requirement	SIPMIU and DSMC	(i) Environmental Clearance (ii) Consent to Establish (Water) (iii) Consent to Establish (Air) (iv) Authorization for setting up waste processing and disposal facility; (v) Tree-cutting Permit	Checking of Records	(i) No violations of EC/Consents to Establish/tree-cutting permit; (ii) Two trees planted for every tree cut	Once prior to construction and once before completion of works	SIPMIU
Location Consideration	Not applicable	SIPMIU and DSC	"No-Development Buffer Zone" declared	Checking of official record	Declaration papers	Once	SIPMIU
Social and Cultural Resources	As per site requirement	SIPMIU and DSMC	Chance Finds Protocol	Checking of records	Chance Finds Protocol provided to construction contractors prior to commencement of activities	Once	SIPMIU
Construction work camps, hot mix plants, stockpile areas,	As per site requirement	SIPMIU and DSMC to determine locations	List of selected location for construction work camps, hot mix	Checking of records	List of selected sites for construction work camps, hot mix	Once	SIPMIU

Field	Location	Responsible for Mitigation	Monitoring of Mitigation	Method of Monitoring	Indicators/ Standards	Frequency	Responsible for Monitoring
storage areas, and disposal areas.		prior to award of construction contracts.	plants, stockpile areas, storage areas, and disposal areas.		plants, stockpile areas, storage areas, and disposal areas provided to construction contractors prior to commencement of works.		
Sources of Materials	As per site requirement	SIPMIU and DSMC to prepare list of approved quarry sites and sources of materials	(i)List of approved quarry sites and sources of materials; (ii) Bid document to include requirement for verification of suitability of sources and permit for additional quarry sites if necessary.	Checking of records	(i) List of approved quarry sites and sources of materials provided to construction contractors (ii) Bid document included requirement for verification of suitability of sources and permit for additional quarry sites if necessary.	Once	SIPMIU
Landfill Operations Manual	As per site requirement	provide information	(i) O&M Manual	Checking of Records	Prior to commissioning of landfill	Once	SIPMIU

DSMC = Design Supervision Management Consultant, O&M = operation and maintenance, SIPMIU = State-level Investment Program Management and Implementation Units.

Table 24: Construction Environmental Monitoring Program

Field	Location	Responsible for Mitigation	Monitoring of Mitigation	Method of Monitoring	Indicators/ Standards	Frequency	Responsible for Monitoring
Sources of Materials	Quarries and sources of	Construction Contractor	Construction Contractor documentation	(i) Checking of records;	(i) Sites are permitted;	Monthly submission	DSMC

Field	Location	Responsible for Mitigation	Monitoring of Mitigation	Method of Monitoring	Indicators/ Standards	Frequency	Responsible for Monitoring
	materials			(ii) visual inspection of sites	(ii) Report submitted by construction contractor monthly (until such time there is excavation work)	for construction contractor As needed for DSMC	
Air Quality	Construction sites and areas designated for stockpiling of materials	Construction Contractor	(i) Location of stockpiles; (ii) complaints from sensitive receptors; (iii) heavy equipment and machinery with air pollution control devices; (iv) ambient air for respirable particulate matter (RPM) and suspended particulate matter (SPM); (v) vehicular emissions such as sulphur dioxide, nitrous oxides, carbon monoxide, and hydrocarbons.	(i) Checking of records; (ii) visual inspection of sites	(i) Stockpiles on designated areas only; (ii) complaints from sensitive receptors satisfactorily addressed; (iii) air pollution control devices working properly; (iv) Government of India Ambient Quality Standards for ambient air quality; (v) Government of India Vehicular Emission Standards for sulphur dioxide, nitrous oxides, carbon monoxide and hydrocarbons.	Monthly for checking records	DSMC in coordination with Pollution Control Board
Surface Water Quality	(i) Construction sites; (ii) areas for	Construction Contractor	(i) Areas for stockpiles, storage of fuels and lubricants and waste materials; (ii) number of	visual inspection	(i) Designated areas only; (ii) silt traps installed and	Monthly	DSMC in coordination with Pollution Control Board

Field	Location	Responsible for Mitigation	Monitoring of Mitigation	Method of Monitoring	Indicators/ Standards	Frequency	Responsible for Monitoring
	stockpiles, storage of fuels and lubricants and waste materials;		silt traps installed along drainages leading to water bodies; (iii) records of surface water quality inspection; (iv) effectiveness of water management measures; (v) for inland water: suspended solids, oil and grease, biological oxygen demand (BOD), and coliforms.		functioning; (iii) no noticeable increase in suspended solids and silt from construction activities (iv) Government of India Standards for Water Discharges to Inland Waters and Land for Irrigation		
Noise Levels	(i) Construction sites; (ii) areas for stockpiles, storage of fuels and lubricants and waste materials; (iii) work camps	Construction Contractor	(i) Complaints from sensitive receptors; (ii) use of silencers in noise-producing equipment and sound barriers; (iii) Equivalent day and night time noise levels	(i) Checking of records; (ii) visual inspection	(i) Complaints from sensitive receptors satisfactorily addressed; (ii) silencers in noise-producing equipment functioning as design; and (iii) sound barriers installed where necessary	Monthly	DSMC in coordination with Pollution Control Board
Landscape and Aesthetics	(i) Construction sites; (ii) areas for stockpiles, storage of fuels and lubricants and waste materials;	Construction Contractor	Waste Management Plan; complaints from sensitive receptors; SIPMIU/DSMC to report in writing that the necessary environmental restoration work has been adequately	(i) Checking of records; (ii) visual inspection	No accumulation of solid wastes on-site; implementation of Waste Management Plan; complaints from sensitive receptors	Monthly	DSMC

Field	Location	Responsible for Mitigation	Monitoring of Mitigation	Method of Monitoring	Indicators/ Standards	Frequency	Responsible for Monitoring
	(iii) work camps		performed before acceptance of work.		satisfactorily addressed.		
Accessibility	(i) Construction sites; (ii) traffic haul road	Construction Contractor	Traffic Management Plan; complaints from sensitive receptors; number of signages placed at subproject location.	Visual inspection	(i) Implementation of Traffic Management Plan, if required; (ii) complaints from sensitive receptors satisfactorily addressed; (iii) signages visible and located in designated areas	Monthly	DSMC
Socio-Economic - Income	Construction sites	Construction Contractor	(i) Complaints from sensitive receptors; (ii) number of walkways, signages, and metal sheets placed at subproject location.	Visual inspection	(i) Complaints from sensitive receptors satisfactorily addressed; (ii) walkways, ramps, and metal sheets provided (iii) signages visible and located in designated areas	Quarterly	DSMC
Socio-Economic - Employment	construction sites	Construction Contractor	(i) Employment records; (ii) records of sources of materials	Checking of records	Number of employees from Aizawl equal or greater than 50% of total workforce	Quarterly	DSMC
Occupational Health and Safety	construction sites	Construction Contractor	(i) Site-specific Health and Safety (H&S) Plan; (ii) Equipped first-aid stations;	(i) Checking of records; (ii) visual inspection	(i) Implementation of H&S plan; (ii) number of	Quarterly	DSMC

Field	Location	Responsible for Mitigation	Monitoring of Mitigation	Method of Monitoring	Indicators/ Standards	Frequency	Responsible for Monitoring
			(iii) Medical insurance coverage for workers; (iv) Number of accidents; (v) Supplies of potable drinking water; (vi) Clean eating areas where workers are not exposed to hazardous or noxious substances; (vii) record of H&S orientation trainings (viii) personal protective equipments; (ix) % of moving equipment outfitted with audible back-up alarms; (x) sign boards for hazardous areas such as energized electrical devices and lines, service rooms housing high voltage equipment, and areas for storage and disposal.		work-related accidents; (iii) % usage of personal protective equipment; (iv) number of first-aid stations, frequency of potable water delivery, provision of clean eating area, and number of sign boards are according to approved plan; (v) % of moving equipment outfitted with audible back-up alarms		
Community Health and Safety	Construction sites	Construction Contractor	(i)Traffic Management Plan; (ii) complaints from sensitive receptors	Visual inspection	(i) Implementation of Traffic Management Plan; (ii) complaints from sensitive receptors satisfactorily	Quarterly	DSMC

Field	Location	Responsible for Mitigation	Monitoring of Mitigation	Method of Monitoring	Indicators/ Standards	Frequency	Responsible for Monitoring
					addressed		
Quarry Sites and Borrow Pits	All quarries and borrow pits	Construction Contractor	(i) List of approved quarry sites and borrow pits; (ii)SIPMIU/DSMC report in writing that all necessary environmental restoration work has been adequately performed before acceptance of work.	Visual inspection	(i) Sites are permitted; (ii) Report submitted by construction contractor monthly (until such time there is excavation work)	Quarterly	DSMC
Work Camps	Work camps	Construction Contractor	(i) Complaints from sensitive receptors; (ii) water and sanitation facilities for employees; and (iii) SIPMIU/DSMC report in writing that the camp has been vacated and restored to pre-project conditions	Visual inspection	(i) Designated areas only; (ii) complaints from sensitive receptors satisfactorily addressed	Quarterly	DSMC
Chance Finds	Construction sites	Construction Contractor	Records of chance finds	Checking of records	Implementation of Chance Finds Protocol	As needed	DSMC

BOD = biological oxygen demand, DSMC = Design Supervision Management Consultant, H&S = health and safety, RPM = respirable particulate matter, SIPMIU = State-level Investment Program Management and Implementation Units SPM = suspended particulate matter.

Table 25: Operation and Maintenance Environmental Monitoring Program (Proposed Landfill)

Field	Location	Responsible for Mitigation	Monitoring of Mitigation	Method of Monitoring	Indicators/ Standards	Frequency	Responsible for Monitoring
Leachate Control	Landfill site and service area	O&M contractor, AMC	(i) Records available	Checking of relevant records	complaints from sensitive receptors satisfactorily addressed	as needed	AMC
Dust Control	Landfill site and service	O&M contractor, AMC	(i) Records available	Checking of relevant	complaints from sensitive	as needed	AMC

Field	Location	Responsible for Mitigation	Monitoring of Mitigation	Method of Monitoring	Indicators/ Standards	Frequency	Responsible for Monitoring
	area			records	receptors satisfactorily addressed		
Litter Control	Land fill site	O&M contractor, AMC	(i) Records available	Checking of relevant records	complaints from sensitive receptors satisfactorily addressed	as needed	AMC
Vermin Control	Landfill site	O&M contractor, AMC	Rodents and Flies Control Plan included in O&M Manual	Checking of O&M Manual	complaints from sensitive receptors satisfactorily addressed	as needed	AMC
Odour Control	Landfill site	O&M contractor, AMC	(i) Odour Control Plan included in O&M Manual; (ii) complaints from sensitive receptors	Checking of O&M Manual	complaints from sensitive receptors satisfactorily addressed	as needed	AMC
Noise Abatement	Landfill site and service area	O&M contractor, AMC	(i) Noise Abatement Plan included in O&M Manual; (ii) complaints from sensitive receptors; (iii) Records of Periodic Maintenance available	Checking of O&M Manual		as needed	AMC
Occupational Health and Safety	Landfill site and service area	O&M contractor, UD&PAD	(i) Records of training available; (ii) H&S Plan included in O&M	Checking of records and training module	(i) complaints from sensitive receptors satisfactorily	as needed	AMC
Community Health and Safety	Landfill site and service area	O&M contractor, AMC	(i) Records available	Checking of records	i) complaints from sensitive receptors	As needed	AMC

Field	Location	Responsible for Mitigation	Monitoring of Mitigation	Method of Monitoring	Indicators/ Standards	Frequency	Responsible for Monitoring
					satisfactorily		
Water Quality	(i) Landfill waste water; (ii) nearby water bodies	AMC in coordination with PHED and O&M Contractors	(i) Inland parameters: colour and odour, suspended solids, particle size of suspended solids, pH value, temperature, oil and grease, total residual chlorine, ammonical nitrogen, total Kjeldahl nitrogen, free ammonia, biochemical oxygen demand, chemical oxygen demand, heavy metals, cyanide, fluoride, dissolved phosphates, sulfide and phenolic compounds. (ii) Land for Irrigation: colour and odour, suspended solids, pH value, oil and grease, biochemical oxygen demand,	Sample collection and laboratory analyses	Government of India Standards for Discharges to Inland Waters and Land for Irrigation	Quarterly or as prescribed by CPCB	AMC

Field	Location	Responsible for Mitigation	Monitoring of Mitigation	Method of Monitoring	Indicators/ Standards	Frequency	Responsible for Monitoring
			arsenic, and cyanide				

CPCB = Central Pollution Control Board O&M = operation and maintenance, PHED = Public Health and Engineering Department, AMC = Aizawl Municipal Council.

Table 26: Operation and Maintenance Environmental Monitoring Program (Closed Dumping Site)

Field	Location	Responsible for Mitigation	Monitoring of Mitigation	Method of Monitoring	Indicators/ Standards	Frequency	Responsible for Monitoring
Leachate Control	Closed Landfill site and service area	O&M contractor, AMC	(i) Records available	Checking of relevant records	complaints from sensitive receptors satisfactorily addressed	as needed	AMC
Dust Control	Closed Landfill site and service area	O&M contractor, AMC	(i) Records available	Checking of relevant records	complaints from sensitive receptors satisfactorily addressed	as needed	AMC
Litter Control	Closed Land fill site	O&M contractor, AMC	(i) Records available	Checking of relevant records	complaints from sensitive receptors satisfactorily addressed	as needed	AMC
Vermin Control	Closed Land fill site	O&M contractor, AMC	Rodents and Flies Control Plan included in O&M Manual	Checking of O&M Manual	complaints from sensitive receptors satisfactorily addressed	as needed	AMC
Odour Control	Closed Land fill site	O&M contractor, AMC	(i) Odour Control Plan included in O&M Manual; (ii) complaints from sensitive receptors	Checking of O&M Manual	complaints from sensitive receptors satisfactorily addressed	as needed	AMC
Noise Abatement	Closed Land fill site	O&M contractor, AMC	(i) Noise Abatement Plan included in O&M Manual;	Checking of O&M Manual		as needed	AMC

Field	Location	Responsible for Mitigation	Monitoring of Mitigation	Method of Monitoring	Indicators/ Standards	Frequency	Responsible for Monitoring
			(ii) complaints from sensitive receptors; (iii) Records of Periodic Maintenance available				
Occupational Health and Safety	Closed Land fill site	O&M contractor, AMC	(i) Records of training available; (ii) H&S Plan included in O&M	Checking of records and training module	(i) complaints from sensitive receptors satisfactorily	as needed	AMC
Community Health and Safety	Landfill site and service area	O&M contractor, AMC	(i) Records available	Checking of records	i) complaints from sensitive receptors satisfactorily	As needed	AMC
Water Quality	(i) Landfill waste water; (ii) nearby water bodies	AMC in coordination with PHED and O&M Contractors	(i) Inland parameters: colour and odour, suspended solids, particle size of suspended solids, pH value, temperature, oil and grease, total residual chlorine, ammonical nitrogen, total Kjeldahl nitrogen, free ammonia, biochemical oxygen demand, chemical oxygen demand, heavy metals, cyanide,	Sample collection and laboratory analyses	Government of India Standards for Discharges to Inland Waters and Land for Irrigation	Quarterly or as prescribed by CPCB	AMC

Field	Location	Responsible for Mitigation	Monitoring of Mitigation	Method of Monitoring	Indicators/ Standards	Frequency	Responsible for Monitoring
			fluoride, dissolved phosphates, sulfide and phenolic compounds. (ii) Land for Irrigation: colour and odour, suspended solids, pH value, oil and grease, biochemical oxygen demand, arsenic, and cyanide				

Table 27: Operation and Maintenance Environmental Monitoring Program (Landfill Facilities)

Field	Location	Responsible for Mitigation	Monitoring of Mitigation	Method of Monitoring	Indicators/ Standards	Frequency	Responsible for Monitoring
Air Quality	Designated for stockpiling of materials	AMC	(i) Location of stockpiles; (ii) complaints from sensitive receptors; (iii) heavy equipment and machinery with air pollution control devices; (iv) ambient air for respirable particulate matter (RPM) and suspended particulate matter (SPM); (v) Vehicular emissions such as sulphur dioxide, nitrous oxides,	(i) Checking of records; (ii) visual inspection of sites	(i) Stockpiles on designated areas only; (ii) complaints from sensitive receptors satisfactorily addressed; (iii) air pollution control devices working properly; (iv) Government of India Ambient Quality Standards for ambient air	Monthly for checking records	AMC in coordination with Pollution Control Board

Field	Location	Responsible for Mitigation	Monitoring of Mitigation	Method of Monitoring	Indicators/ Standards	Frequency	Responsible for Monitoring
			carbon monoxide, and hydrocarbons.		quality; (v) Government of India Vehicular Emission Standards for sulphur dioxide, nitrous oxides, carbon monoxide and hydrocarbons.		
Surface Water Quality	(i) Construction sites; (ii) areas for stockpiles, storage of fuels and lubricants and waste materials;	AMC	(i) Areas for stockpiles, storage of fuels and lubricants and waste materials; (ii) number of silt traps installed along drainages leading to water bodies; (iii) records of surface water quality inspection; (iv) effectiveness of water management measures; (v) for inland water: suspended solids, oil and grease, biological oxygen demand (BOD), and coliforms.	visual inspection	(i) Designated areas only; (ii) silt traps installed and functioning; (iii) no noticeable increase in suspended solids and silt from construction activities (iv) Government of India Standards for Water Discharges to Inland Waters and Land for Irrigation	Monthly	AMC in coordination with Pollution Control Board
Noise Levels	(i) Working sites; (ii) areas for stockpiles, storage of fuels and lubricants and waste materials;	AMC	(i) Complaints from sensitive receptors; (ii) use of silencers in noise-producing equipment and sound barriers; (iii) Equivalent day and night time noise levels	(i) Checking of records; (ii) visual inspection	(i) Complaints from sensitive receptors satisfactorily addressed; (ii) silencers in noise-producing equipment functioning as	Monthly	AMC in coordination with Pollution Control Board

Field	Location	Responsible for Mitigation	Monitoring of Mitigation	Method of Monitoring	Indicators/ Standards	Frequency	Responsible for Monitoring
	(iii) work camps				design; and (iii) sound barriers installed where necessary		
Landscape and Aesthetics	(i) Working sites; (ii) areas for stockpiles, storage of fuels and lubricants and waste materials; (iii) work camps	AMC	Waste Management Plan; complaints from sensitive receptors; SIPMIU/DSMC to report in writing that the necessary environmental restoration work has been adequately performed before acceptance of work.	(i) Checking of records; (ii) visual inspection	No accumulation of solid wastes on-site; implementation of Waste Management Plan; complaints from sensitive receptors satisfactorily addressed.	Monthly	AMC
Accessibility	(i) Approach Road ; (ii) traffic haul road	AMC	Traffic Management Plan; complaints from sensitive receptors; number of signages placed at subproject location.	Visual inspection	(i) Implementation of Traffic Management Plan, if required; (ii) complaints from sensitive receptors satisfactorily addressed; (iii) signages visible and located in designated areas	Monthly	AMC
Socio-Economic - Income	Working sites	AMC	(i) Complaints from sensitive receptors; (ii) number of walkways, signages, and metal sheets placed at subproject location.	Visual inspection	(i) Complaints from sensitive receptors satisfactorily addressed; (ii) walkways, ramps, and metal	Quarterly	AMC

Field	Location	Responsible for Mitigation	Monitoring of Mitigation	Method of Monitoring	Indicators/ Standards	Frequency	Responsible for Monitoring
					sheets provided (iii) signages visible and located in designated areas		
Socio-Economic - Employment	Working sites	AMC	(i) Employment records; (ii) records of sources of materials	Checking of records	Number of employees from Aizawl equal or greater than 50% of total workforce	Quarterly	AMC
Occupational Health and Safety	Working sites	AMC	(i) Site-specific Health and Safety (H&S) Plan; (ii) Equipped first-aid stations; (iii) Medical insurance coverage for workers; (iv) Number of accidents; (v) Supplies of potable drinking water; (vi) Clean eating areas where workers are not exposed to hazardous or noxious substances; (vii) record of H&S orientation trainings (viii) personal protective equipments; (ix) % of moving equipment outfitted with audible back-up alarms; (x) sign boards for hazardous areas such as energized electrical devices and lines, service rooms housing	(i) Checking of records; (ii) visual inspection	(i) Implementation of H&S plan; (ii) number of work-related accidents; (iii) % usage of personal protective equipment; (iv) number of first-aid stations, frequency of potable water delivery, provision of clean eating area, and number of sign boards are according to approved plan; (v) % of moving equipment outfitted with audible back-up alarms	Quarterly	AMC

Field	Location	Responsible for Mitigation	Monitoring of Mitigation	Method of Monitoring	Indicators/ Standards	Frequency	Responsible for Monitoring
			high voltage equipment, and areas for storage and disposal.				
Community Health and Safety	Working sites	AMC	(i)Traffic Management Plan; (ii) complaints from sensitive receptors	Visual inspection	(i) Implementation of Traffic Management Plan; (ii) complaints from sensitive receptors satisfactorily addressed	Quarterly	AMC

E. Environmental Management Plan Costs

218. Most of the mitigation measures require the Contractors to adopt good site practices, which are part of their normal procedures, so there are unlikely to be major costs associated with compliance. These costs of mitigation by the contractors are included in the budgets for the civil works. Mitigation and monitoring provided by the SIPMIU or its DSMC will be part of incremental administration costs. Costs required for environmental quality monitoring is indicated in Table 28.

Table 28: Environmental Management and Monitoring Costs (INR)

Item	Total Cost (INR Lacs)	Source of Funds
Mitigation Measures (pre-construction)	-	SIPMIU Cost
Mitigation Measures (construction)	-	Construction Contractors Cost
Mitigation Measures (O&M)	-	AMC Cost
Monitoring Measures (Pre-construction)	8.73	DSMC Cost
Monitoring Measures (Construction)	-	Construction Contractor Cost
Monitoring Measures (O&M)		AMC Cost
a. Leachate Monitoring (annual)	-	
b. Odor Monitoring (annual)	-	
c. Wash water (annual)	-	
Capacity Building (pre-construction)	8.89	SIPMIU Cost
Training Sessions (pre-construction)	-	SIPMIU Cost
Training Sessions (construction)	-	SIPMIU Cost
Tree plantation (after construction)	to be determined	SIPMIU Cost
Maintenance of tree plantations (3 years)	to be determined	SIPMIU Cost

VIII. FINDINGS AND RECOMMENDATIONS

219. The process described in this document has assessed the environmental impacts of all elements of the infrastructure proposed under the Aizawl Solid Waste Management Subproject. Potential negative impacts were identified in relation to construction and operation of the improved infrastructure, but no impacts were identified as being due to either the subproject design or location. Mitigation measures have been developed to reduce all negative impacts to acceptable levels. These were discussed with specialists responsible for the engineering aspects, and as a result some measures have already been included in the outline designs for the infrastructure. This means that the number of impacts and their significance has already been reduced by amending the design.

220. Regardless of these and various other actions taken during the IEE process and in developing the project, there will still be impacts on the environment when the infrastructure is built and when it is operating. This is mainly because of the invasive nature of excavation work; because the secondary storage facilities (waste bins) are located in the town, some parts of which are densely populated. Because of these factors the most significant impacts are on the physical environment and human environment.

221. During the construction phase, impacts mainly arise from the need to dispose of large quantities of waste soil produced by excavation at the landfill site. These are common impacts

of construction in and around urban areas, and there are well developed methods for their mitigation.

222. There were limited opportunities to provide environmental enhancements, but certain measures were included. For example it is proposed that the project will employ in the workforce people who live in the vicinity of construction sites to provide them with a short-term economic gain; and plant trees on and around completed parts of the landfill site once it is operating, to improve the appearance and provide a small ecological gain.

223. Once the system is operating, it will be important that AMC maintains the facilities and the waste management system as a whole in proper working order, because the town environment will deteriorate rapidly from waste accumulation if the system begins to fail. The project will provide capacity building, public education and financial support to ensure continuation of the operating system.

224. The main impacts of the operating waste management system will be beneficial as the general environment of the town will improve considerably as mounds of garbage are no longer evident and the appearance, smell and public health of the area improves as a result. Some people will also gain socio-economically from being employed in companies engaged to operate the system, or in the expanded Municipality manpower.

225. Mitigation will be assured by a program of environmental monitoring conducted during construction and operation to ensure that all measures are implemented, and to determine whether the environment is protected as intended. This will include observations on- and off-site, document checks, and interviews with workers and beneficiaries, and any requirements for remedial action will be reported to the SIPMIU. There will also be a longer-term survey to monitor the expected improvements in the town environment from the improved solid waste management.

226. Finally, stakeholders were involved in developing the IEE through face-to-face discussions on site and a large public meeting held in the town, after which views expressed were incorporated into the IEE and the planning and development of the project. The IEE will be made available at public locations in the town and will be disclosed to a wider audience via the ADB website. The consultation process will be continued and expanded during project implementation, when a nationally-recognized NGO will be appointed to handle this key element to ensure that stakeholders are fully engaged in the project and have the opportunity to participate in its development and implementation.

IX. CONCLUSIONS

227. The subproject is unlikely to cause significant adverse impacts. The potential adverse impacts that are associated with design, construction, and operation can be mitigated to standard levels without difficulty through proper engineering design and the incorporation or application of recommended mitigation measures and procedures.

228. Based on the findings of the IEE, the classification of the Project as Category “B” is confirmed, and no further special study or detailed EIA needs to be undertaken to comply with ADB SPS (2009) or Government of India EIA Notification (2006).

Appendix 1: Copy of Environmental Clearance from EAC, MOEF (GOI) for Landfill Site Environmental Clearance

F.No. 10-73/2010-IA.III
Government of India
Ministry of Environment & Forests
(IA-III Division)

Room No. 143,
Paryavaran Bhawan,
CGO Complex, Lodhi Road,
New Delhi - 110 003

Dated: 9th January, 2013

To
Project Director, SIPMIU,
U-5/A, Vega Studio, Laipuitland,
Aizawl – 796 012, Mizoram

Subject: Environmental Clearance for the development of land fill site for Aizawl City in State of Mizoram by M/s Project Director, SIPMIU (NERCCDIP) - Reg.

This has reference to your letter No. W.11020/1/2008-PD/SIPMIU (NERCCDIP)/61 dated 23.04.2012 and subsequent letter dated 01.08.2012 seeking Environmental Clearance under the Environment Impact Assessment Notification, 2006. The proposal has been appraised as per prescribed procedure in the light of provisions under the Environment Impact Assessment Notification, 2006 on the basis of the mandatory documents enclosed with the application viz., the Form I, EIA, EMP, Public Hearing proceedings and the additional clarifications furnished in response to the observations of the Expert Appraisal Committee constituted by the competent authority in its meeting held on 16th - 17th August, 2012.

2. It is inter-alia noted that the proposal involves development of land fill site for Aizawl City in State of Mizoram. The existing system of waste collection is through a manual/multi-handling system, which is not in conformance to the rules. It is proposed to provide additional capacity to city's present SWM work, including additional equipment, storage bins for effective collection of Solid waste, additional vehicle to strengthen effectively and timely transportation of solid wastes to treatment and disposal site, development of land fill site and capacity development for (i) effective public participation in segregation of recyclable waste and storage of waste at source and (ii) primary collection of waste. It is estimated that 103 metric tons per day (mtpd) of solid waste is generated within GAPA. Presently, only 40% - 45% of wastes is collected and transported to the disposal site. The water requirement is approximately 10 KLD. The total cost of the project is Rs. 14 crores. The project is category 'B' and since there is no SEIAA, Mizoram, the project is considered by EAC.

3. The project was examined by the EAC in its meeting held on 18th – 20th January, 2011 and finalized ToR including conduct of Public Hearing. The Public Hearing was conducted on 17.06.2011 at Zemabawk, Aizawal. Major

Office of the Project Director
SIPMIU (NERCCDIP)
Aizawl, Mizoram

issues are nuisance from existing activity. Proponent responded that the new facility will be based on scientific and hence the problem will be minimized.

4. The Expert Appraisal Committee, after due consideration of the relevant documents submitted by the project proponent and additional clarifications furnished in response to its observations, have recommended for the grant of Environmental Clearance for the project. Accordingly, the Ministry hereby accords necessary Environmental Clearance for the above project as per the provisions of Environment Impact Assessment Notification, 2006 and its subsequent amendments, subject to strict compliance of the terms and conditions as follows:

5. **SPECIFIC CONDITIONS:**

(i) The "Consent to Establish" shall be obtained from State Pollution Control Board under Air and Water Act a copy shall be submitted to the Ministry before start of any construction work at the site.

(ii) Existing land fill site shall be closed scientifically.

(iii) The proponent shall ensure that the project fulfills all the provisions of Solid Wastes (Management and Handling) Rules, 2000 including collection and transportation design etc.

(iv) The gas generated from the Landfill facility shall be collected and disposed/utilized as per rules

(v) The Leachate from the facility shall be collected and treated to meet the prescribed standards before disposal.

(vi) The depth of the land fill site shall be decided based on the ground water table at the site.

(vii) An On Site Emergency Management Plan shall be prepared and implemented.

(viii) Periodical ground water/soil monitoring to check the contamination in and around the site shall be carried out.

(ix) Odour control measures shall be carried out.

(x) Green belt of at least 20 % of total area shall be provided all around the unit.

(xi) The project proponent will set up separate environmental management cell for effective implementation of the stipulated environmental safeguards under the supervision of a Senior Executive.

6. **GENERAL CONDITIONS:-**

(i) Full support shall be extended to the officers of this Ministry/ Regional Office at Shillong by the project proponent during inspection of the project for monitoring purposes by furnishing full details and action plan including action taken reports in respect of mitigation measures and other environmental protection activities.

(ii) A six-Monthly monitoring report shall need to be submitted by the project proponents to the Regional Office of this Ministry at Shillong regarding the implementation of the stipulated conditions.

(iii) Ministry of Environment & Forests or any other competent authority may stipulate any additional conditions or modify the existing ones, if necessary in the interest of environment and the same shall be complied with.

(iv) The Ministry reserves the right to revoke this clearance if any of the conditions stipulated are not complied with the satisfaction of the Ministry.

(v) In the event of a change in project profile or change in the implementation agency, a fresh reference shall be made to the Ministry of Environment and Forests.

(vi) The project proponents shall inform the Regional Office as well as the Ministry, the date of financial closure and final approval of the project by the concerned authorities and the date of start of land development work.

(vii) A copy of the clearance letter shall be marked to concerned Panchayat/local NGO, if any, from whom any suggestion/ representation has been made received while processing the proposal.

(viii) State Pollution Control Board shall display a copy of the clearance letter at the Regional Office, District Industries Centre and Collector's Office/ Tehsildar's office for 30 days.

7. These stipulations would be enforced among others under the provisions of Water (Prevention and Control of Pollution) Act 1974, the Air (Prevention and Control of Pollution) Act 1981, the Environment (Protection) Act, 1986, the Public Liability (Insurance) Act, 1991 and EIA Notification 2006, including the amendments and rules made thereafter.

8. All other statutory clearances such as the approvals for storage of diesel from Chief Controller of Explosives, Fire Department, Civil Aviation Department, Forest Conservation Act, 1980 and Wildlife (Protection) Act, 1972 etc. shall be obtained, as applicable by project proponents from the respective competent authorities.

9. The project proponent shall advertise in at least two local Newspapers widely circulated in the region, one of which shall be in the vernacular language informing that the project has been accorded Environmental Clearance and copies of clearance letters are available with the State Pollution Control Board and may also be seen on the website of the Ministry of Environment and Forests at http://www.envfor.nic.in. The advertisement should be made within 10 days from the date of receipt of the Clearance letter and a copy of the same should be forwarded to the Regional office of this Ministry at Shillong.

10. This Clearance is subject to final order of the Hon'ble Supreme Court of India in the matter of Goa Foundation Vs. Union of India in Writ Petition (Civil) No.460 of 2004 as may be applicable to this project.

11. Status of compliance to the various stipulated environmental conditions and environmental safeguards will be uploaded by the project proponent in its website.

12. Any appeal against this clearance shall lie with the National Green Tribunal, if preferred, within a period of 30 days as prescribed under Section 16 of the National Green Tribunal Act, 2010.

13. The environmental statement for each financial year ending 31st March in Form V as is mandated to be submitted by the project proponent to the concerned State Pollution Control Board as prescribed under the Environment (Protection) Rules, 1986, as amended subsequently, shall also be put on the website of the company along with the status of compliance of EC conditions and shall also be sent to the respective Regional Offices of MoEF by e-mail.

(Lalit Kapur)
Director (IA-III)

Copy to:

(1) The Secretary, Department of Environment, Government of Mizoram, Aizawal.
(2) The Chairman, Central Pollution Control Board, Parivesh Bhawan, CBD-cum Office Complex, East Arjun Nagar, Delhi – 110 032.
(3) The Member Secretary, Mizoram State Pollution Control Board, M.G. Road, Khatla, Aizwal-796012, Mizoram
(4) The CCF, Regional Office, Ministry of Environment & Forests (NEZ), Uplands Road, Lautumkhrah, Shillong - 793003.
(5) IA - Division, Monitoring Cell, MOEF, New Delhi - 110003.
(6) Guard file.

(Lalit Kapur)
Director (IA-III)

Appendix 2: No Objection Certifications (Proposed Landfill Site)

This is in the process of renewal. Once obtained, the NOC will be included in the semi-annual environmental monitoring report

PROVISIONAL LAND LEASE CERTIFICATE

[See Rule 7(6)]

No. 22 of 2014

Name of Provisional Certificate Holder	:	Secretary to the Government of Mizoram, UD&PA Dept.
Address	:	Aizawl : Mizoram
Location	:	Zemabawk, Bungmual
Purpose	:	Solid Waste Management Plan
Area in Bigha & Sqm.	:	96.80 bighas = 129548.00 sqm.
Period of Validity	:	Six (6) month w.e.f. June,2014 to Nov,2014

Government Vide No.K15011/138/2012-REV Dt.4.6.2014

The holder of this Provisional Land Lease Certificate will be issued Land Lease Certificate after completion of these conditions:-

1. Properly demarcated with the assistance of Revenue Department using boundary pillars prescribed by the Revenue Department.
2. Boundary wall or proper fencing shall be put up by the allottee within six (6) months from the date of issue of Provisional Land Lease Certificate.
3. On satisfactory fulfilment of above two conditions the holder of this Provisional Land Lease Certificate shall apply for issue of Land Lease Certificate.

14/6/14

(R.LALRAMNGHAKA)
Director
Land Revenue & Settlement
Mizoram : Aizawl

Name of Lessee : URBAN DEVELOPMENT & POVERTY ALLEVIATION DEPARTMENT
GOVT. OF MIZORAM
Purpose : SOLID WASTE MANAGEMENT PLAN.
Location : ZEMABAWK,BUNGMUAL. DAMDIAI LUI & BAMBOO ROAD INKAR
Town : ZEMABAWK LOCAL COUNCIL
Previous Registration No.
1. Garden Lsc. No. 3 of 1999. Pass Area : 8.85 Bigha 2. Garden Lsc. No. 284 of 2009. Pass Area : 24.23 Bigha
3. Garden P/P. No. 77 of 2005. Pass Area : 6.27 Bigha 4. Garden P/P. No. 100 of 2005. Pass Area : 9.52 Bigha
5. Garden P/P. No. 101 of 2005. Pass Area 9.76 Bigha **Total Pass Area : .58.63.Bigha**

Date of Survey :2.8.2013 - 6.8.2013 Scale : 1 : 4000 . Survey Area :.129548.00 Sq.m.
Grade : III . 96.80 Bigha.
. 12.95 Hactare

Demarcated by	Checked by	Countersigned by
(LALTHAKIMA) Surveyor D.L.R & S. Mizoram:Aizawl	(H. REMTLUANGA.) Surveyor D.L.R & S. Mizoram:Aizawl	Asst. Director of Survey, Revenue & Settlement, Mizoram, Aizawl

Approved by

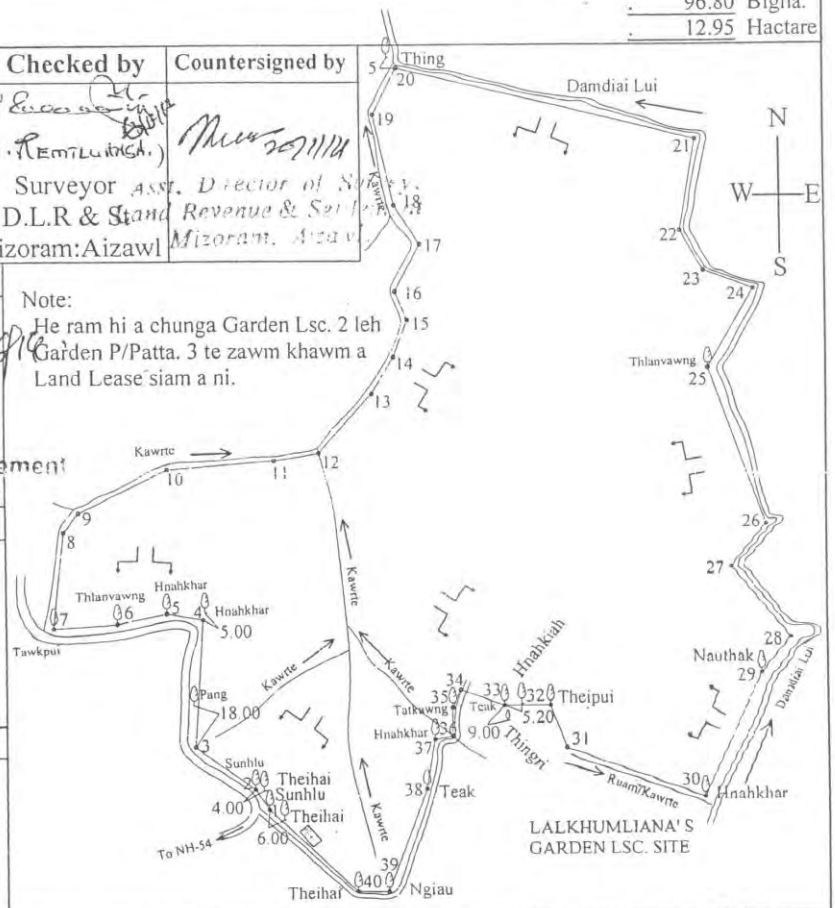
17/6/14

Director
Land Revenue & Settlement
Mizoram : Aizawl

Accepted by

Issued by

Note:
He ram hi a chunga Garden Lsc. 2 leh Garden P/Patta. 3 te zawm khawm a Land Lease siam a ni.



LINE	S/D	H/D	F/B	V/A	V/H
1 2	16.00	16.00	326°	0°	0
2 3	47.00	47.00	306°	0°	0
3 4	82.00	82.00	4°	0°	0
4 5	24.00	24.00	280°	0°	0
5 6	32.00	32.00	258°	0°	0
6 7	40.00	40.00	266°	0°	0
7 8	68.00	61.62	6°	25°	-28.73
8 9	16.00	15.75	37°	10°	-2.77
9 10	64.00	63.02	63°	10°	-11.11
10 11	70.00	68.93	85°	10°	-12.05
11 12	30.00	29.54	80°	10°	-5.21
12 13	53.00	52.19	42°	10°	-9.20
13 14	28.00	27.57	30°	10°	-12.99
14 15	26.00	25.60	20°	10°	-4.51
15 16	20.00	19.69	337°	10°	-1.75
16 17	35.00	34.46	27°	10°	-6.07
17 18	30.00	29.54	327°	10°	-5.20
18 19	60.00	59.08	347°	10°	-10.42
19 20	34.00	33.48	27°	10°	-5.90
20 21	200.00	196.96	103°	10°	34.73

LINE	S/D	H/D	F/B	V/A	V/H
21 22	60.00	59.08	190°	10°	10.41
22 23	30.00	29.54	150°	10°	5.21
23 24	35.00	34.46	110°	10°	6.07
24 25	60.00	59.08	210°	10°	10.42
25 26	110.00	108.33	160°	10°	19.10
26 27	36.00	35.45	220°	10°	6.25
27 28	60.00	59.08	140°	10°	10.41
28 29	30.00	29.54	220°	10°	5.21
29 30	90.00	88.63	205°	10°	15.62
30 31	110.00	95.26	290°	30°	54.99
31 32	30.00	28.97	340°	15°	-8.03
32 33	30.00	28.97	270°	15°	-8.03
33 34	34.00	29.44	290°	30°	-16.99
34 35	13.00	12.56	290°	15°	3.36
35 36	19.00	18.35	180°	15°	4.91
36 37	12.00	11.59	260°	15°	3.10
37 38	34.00	32.84	190°	15°	8.79
38 39	74.00	71.48	200°	15°	19.15
39 40	20.00	20.00	271°	0°	0
40 1	79.00	79.00	313°	0°	0

Appendix 3: Tree felling Permission for Land fill site from Forest Department, Govt of Mizoram

GOVERNMENT OF MIZORAM
OFFICE OF THE PRINCIPAL CHIEF CONSERVATOR OF FORESTS
MIZORAM:::AIZAWL

No.C.18012/21/97-PCCF(CON)/362 Dated Aizawl the 1 7th June, 2011

To

Shri Valbuanga,
Project Director,
State Investment Program Management &
Implementation Unit (SIPMIU),
U-5/A, Vega Studio,
Laipuitlang, Aizawl

Subj:- Pemission for cutting trees at the location of Sewage Treatment Plant (STP) at Chite Lui (Pu Chawngthanga ram chhung) and Landfill Development for Solid Waste Management (SWM) at Tuirial.

Sir,

With reference to your letter No.W-11020/1/2008-PD/SIPMIU(NERCCDIP)/15 dt.22.3.2011 on the subject cited above, I am to inform you that SIPMIU is permitted to fell 70 nos. of trees, 150 no. of poles and 8 nos. of Teak trees standing on the project site as the area is outside notified forest or forest as defined by the Hon'ble Supreme Court of India in its order dated 12.12.1996 in W.P(C) No.202/95 as per verification report of Divisional Forest Officer, Aizawl Forest Division.

1/6/2011

(ROSIAMA VANCHHONG)
Chief Conservator of Forests &
Nodal Officer (FCA)
Mizoram, Aizawl

Copy to :

1. Conservator of Forests (CentralCircle) for information.
2. DFO, Aizawl Forest Division for information.
3. NOC Guard File.

1/6/11

(VANLALCHUAILOVA)
Deputy Conservator of Forests (Hqrs)
Mizoram, Aizawl

Appendix 4: Copy of Consent for Establishment of Mechanical Compost Plant & Engineering Land Fill Site

OFFICE OF THE MIZORAM STATE POLLUTION CONTROL BOARD
AIZAWL : MIZORAM

NO OBJECTION CERTIFICATE (CONSENT TO ESTABLISH)
(RENEWED)

No. H.88088/Polln/9(154)/2011-MPCB/ : Dated Aizawl, the 10th October, 2014

NO OBJECTION CERTIFICATE (CONSENT TO ESTABLISH) granted to the **PROJECT DIRECTOR, STATE INVESTMENT PROGRAM MANAGEMENT & IMPLEMENTATION UNIT (SIPMIU), GOVERNMENT OF MIZORAM** for setting up of **Compost Plant with Engineered Landfill having a capacity of 150 tons/day for Solid Wastes management of Aizawl city at Tuirial, Mizoram** under Section 21 of Air (Prevention & Control of Pollution) Act, 1981 and Section 25/26 of Water (Prevention & Control of Pollution) Act, 1974 is hereby *renewed for another one (1) year with effect from 10th August, 2013* with reference to the application No. W. 11020/6/2008-PD/SIPMIU (NERCCDIP)/81 Dt. 18.09.2014.

All the conditions stipulated in the original certificate shall remain same and shall be strictly complied with.

(C. LALDUHAWMA)
Member Secretary
Mizoram Pollution Control Board

Memo No. H.88088/Polln/9(154)/2011-MPCB/ : Dated Aizawl, the 10th October, 2014

Copy to :

1. The Director of Industries, Govt. of Mizoram, Aizawl for favour of information.
2. **PROJECT DIRECTOR, STATE INVESTMENT PROGRAM MANAGEMENT & IMPLEMENTATION UNIT (SIPMIU), GOVERNMENT OF MIZORAM** with reference to the application No. W. 11020/6/2008-PD/SIPMIU (NERCCDIP)/81 Dt.18.09.2014.

(C. LALDUHAWMA)
Member Secretary
Mizoram Pollution Control Board

Mizoram Pollution Control Board, "Silver House", Tuikhuahtlang, Aizawl, Mizoram-796001
Ph.No.2326172/2316590 Fax: 2316591 (mail: mizompcb@...) Website: http://www.mizoenvis.nic.in

Appendix 5: Copy of Consent for Establishment of Vermi – Compost Plant

OFFICE OF THE MIZORAM STATE POLLUTION CONTROL BOARD
AIZAWL: MIZORAM

CONSENT TO ESTABLISH
(NO OBJECTION CERTIFICATE)

No.H.88088/Poltn/9 (154)/2011-MPCB/307 : Dated Aizawl, the 10th February, 2015

CONSENT TO ESTABLISH (NO OBJECTION CERTIFICATE) is hereby granted to **M/s SIPMIU, MIZORAM** for setting up of **Vermi Compost Plant** at **Tuirial, Aizawl, Mizoram** having an installed production capacity of **22 TPD** under Section 21 of Air (Prevention & Control of Pollution) Act, 1981 as amended and Section 25/26 of Water (Prevention & Control of Pollution) Act, 1974 as amended (to be referred as Air Act and Water Act respectively) with reference to their application No. Nil (Form No.1789) dated 21.01.2015 and subsequent correspondence including site verification under the following terms and conditions:-

1. No air, water and soil pollution shall be created by the industry beyond the prescribed permissible limits.
2. As per the provision of Water (Prevention & Control of Pollution) Act, 1974 as amended and Air (Prevention & Control of Pollution) Act, 1981 as amended, any officer empowered by the Board on its behalf shall, have without any interruption, the right at any time to enter the industry for inspection, collection of sample for analysis and may call for any information etc. Violation of this right will cause withdrawal of this consent.
3. It shall be the prime responsibility of the industry that the nearby population, vegetation and any other assets etc. shall not be affected due to emission/effluent emanating out of the industry.
4. All efforts should be made by the industry's authority to maintain the ambient air quality of the area to the lowest possible limits well below the prescribed permissible limits by utilizing the best available technologies in this regard.
5. Efforts shall have to be made by the industry for recycle and recovery of waste to the maximum extent possible.
6. There should be an odour control system to reduce foul odour from the process.
7. The industry shall have to submit a detailed report on compliance to the terms and conditions as laid down in this Certificate and to apply for **Consent to Operate** before commissioning of the plant. No operation of the plant shall be allowed unless the industry fulfilled all the stipulated terms and conditions of this Certificate.
8. This Certificate has been accorded basing on the particulars furnished by the applicant on behalf of **M/s SIPMIU, MIZORAM,** and subject to addition of further or more conditions if so warranted by subsequent developments. The consent will automatically become invalid if any change or alteration or deviation is made in actual practice.

This certificate will remain valid for a period of **1(one)** year from the date of issue.

MIZORAM STATE POLLUTION CONTROL BOARD * AIZAWL *

(C.LALDUHAWMA)
Member Secretary,

Memo No.H.88088/Poltn/9 (154)/2011-MPCB/ : Dated Aizawl, the 10th February, 2015

Copy to: The Project Director, State Investment Program Management & Implementation Unit (SIPMIU), Government of Mizoram & Proprietor **M/S VERMI COMPOST PLANT, TUIRIAL, MIZORAM** with reference to the application No. NIL dt 20.1.2015

(C.LALDUHAWMA)
Member Secretary
Mizoram Pollution Control Board

Mizoram Pollution Control Board, 'Silver House', Tuikhuahtlang, Aizawl, Mizoram-796001
Ph.No.2326173/2316590 Fax: 2316591 Email:mizorampcb@gmail.com Website:http://www.mizenvis.nic.in

Appendix 6: NOC from Aviation Wing of General Administration Department for Proposed Landfill Site

152

NO.D.13020/1/2011-GAD(AV)
GOVERNMENT OF MIZORAM
GENERAL ADMINISTRATION DEPARTMENT
(AVIATION WING)

Dated Aizawl, the 9th October 2012.

To,

The Project Director,
SIPMIU,
Aizawl.

Subj : **Issue of No Objection Certificate**

Ref : **No.W.11012/11/2007-PD/SIPMIU(NER CCDIP)/151 dt 9.10.2012**

Sir,

With reference to the above letter no. and aforementioned subject, the **No Objection Certificate** for setting up Sanitary landfill at Tuirial is hereby granted subject to compliance with the undertakings at form 1A & 1B. Smoke emission, if any, should be minimal and should not cause safety hazard for operating aircrafts at Lengpui Airport.

Yours faithfully,

9/10/12

(Wg.Cdr.LALZAWMA)
Principal Consultant,
GAD, Aviation Wing.

Office of the Project Director
SIPMIU (NERCCDIP)
Aizawl, Mizoram.
Receipt No. 467
10/10/12

17/10/12

Appendix 7: ADB Rapid Environmental Assessment Checklist for Solid waste Management

1. This checklist is to be prepared to support the environmental classification of a project. It is to be attached to the environmental categorization form that is to be prepared and submitted to the Chief Compliance Officer of the Regional and Sustainable Development Department.

2. This checklist is to be completed with the assistance of an Environment Specialist in a Regional Department.

3. This checklist focuses on environmental issues and concerns. To ensure that social dimensions are adequately considered, refer also to ADB checklists and handbooks on (i) involuntary resettlement, (ii) indigenous peoples planning, (iii) poverty reduction, (iv) participation, and (v) gender and development.

4. Answer the questions assuming the "without mitigation" case. The purpose is to identify potential impacts. Use the "remarks" section to discuss any anticipated mitigation measures.

Screening Questions	Yes	No	Remarks
A. Project Siting Is the project area…			
• Densely populated?		✓	Aizawl is not densely populated. There are no heavy development activities in the subproject area. There are no habitations within 4 km radius of the SLF site.
• Heavy with development activities?		✓	
Adjacent to or within any environmentally sensitive areas?			No protected areas/ecologically sensitive areas within 10 km radius of the subproject.
• Cultural heritage site		✓	
• Protected Area		✓	
• Wetland		✓	
• Mangrove		✓	
• Estuarine		✓	
• Buffer zone of protected area		✓	
• Special area for protecting biodiversity		✓	
• Bay		✓	
B. Potential Environmental Impacts Will the Project cause…			
• Impacts associated with transport of wastes to the disposal site or treatment facility		✓	Not anticipated. Only covered vehicle will be engaged in collection and transportation of solid wastes.
• Impairment of historical/cultural monuments/areas and loss/damage to these sites?		✓	Not applicable. There are no historical/cultural monuments/areas within or adjacent to SLF site.
• Degradation of aesthetic and property value loss?		✓	Not anticipated. There will be positive impact on aesthetic and property value of Aizawl as the city will be more clean and hygienic. The subproject will stop the existing practice of open dumping resulting to improved aesthetic and increase property values.
• Nuisance to neighboring areas due to		✓	Not anticipated. The subproject will

Screening Questions	Yes	No	Remarks
foul odor and influx of insects, rodents, etc.?			improve current practice of open dumping. SLF O&M manual will include mitigation measures to control insects, vectors, etc.
• Dislocation or involuntary resettlement of people?		✓	Not applicable.
• Public health hazards from odor, smoke from fire, and diseases transmitted by flies, insects, birds and rats?		✓	Not anticipated. The subproject will improve current practice of open dumping. SLF O&M manual will include mitigation measures to control insects, vectors, etc. No habitation within 4 km radius of the SLF site.
• Deterioration of water quality as a result of contamination of receiving waters by leachate from land disposal system?		✓	Not anticipated. SLF design includes leachate collection and treatment systems. Treated water from leachate will be re-used in the composting plant and active SLF cells. SLF O&M manual will include environmental monitoring program. Any discharge must comply with Government of India Central Pollution Control Board (CPCB) standards.
• Contamination of ground and/or surface water by leachate from land disposal system?		✓	Not anticipated. Although contamination is unlikely to occur, provision will be ensured to collect leachate water and treated as per standard applicable norm further this water will be re-used in composting plant. Regular monitoring and testing will be carried out.
• Land use conflicts?		✓	Not anticipated. SLF site has been acquired by the government for the subproject. AMC has designated the area for intended use.
• Pollution of surface and ground water from leachate coming from sanitary landfill sites or methane gas produced from decomposition of solid wastes in the absence of air, which could enter the aquifer or escape through soil fissures at places far from the landfill site?		✓	Not anticipated. SLF design includes leachate collection and treatment systems. Treated water from leachate will be re-used in the composting plant and active SLF cells. Also included in the design are gas vents to ensure methane is monitored. SLF O&M manual will include environmental monitoring program.
• Inadequate buffer zone around landfill site to alleviate nuisances?		✓	Not anticipated. SLF design includes 500-m buffer zone which will be declared by AMC as “no development zone”.
• Social conflicts if workers from other regions or countries are hired?		✓	Priority in employment will be given to local residents.
• Road blocking and/or increased traffic during construction of facilities?		✓	Not anticipated. During construction no road blocking or traffic diversion will be required as SLF site is approximately 3 km away from nearby road (NH 54). There will be separate approach road that will connect the SLF to NH54.
• Noise and dust from construction activities?	✓		Anticipated during construction activities. Temporary increase in noise level and dusts may be caused by excavation equipment, and the transportation of

Screening Questions	Yes	No	Remarks
			equipment, materials, and people. The impacts are negative but short-term and site-specific within a relatively small area and reversible through mitigation measures. Good construction practices will mitigate noise and dust, and will be specified in the EMP.
• Temporary silt runoff due to construction?	✓		Due to excavation and run-off from stockpiled materials. The impacts are negative but short-term and site-specific within a relatively small area and reversible through mitigation measures. Good construction practices will mitigate soil erosion and silt runoff and will be specified in the EMP.
• Hazards to public health due to inadequate management of landfill site caused by inadequate institutional and financial capabilities for the management of the landfill operation?		✓	Not anticipated. Subproject will build capacity of AMC to manage the improved solid waste management system. There will be separate provision of fund in implementing agency for management of O&M.
• Emission of potentially toxic volatile organics from land disposal site?		✓	Not anticipated. There will be integrated segregation and composting plant to ensure only inorganic waste will disposed in the SLF thus emission of volatile organics is not significant..
• Surface and ground water pollution from leachate and methane gas migration?		✓	Not anticipated. SLF design includes leachate treatment and gas venting.
• Loss of deep-rooted vegetation (e.g. tress) from landfill gas?		✓	Not anticipated. No deep–rooted vegetation found in the SLF site.
• Explosion of toxic response from accumulated landfill gas in buildings?		✓	Not anticipated. SLF design includes gas venting. There are no human settlements within the 4 km radius of the SLF site.
• Contamination of air quality from incineration?		✓	Not applicable. Incineration is included in the subproject.
• Public health hazards from odor, smoke from fire, and diseases transmitted by flies, rodents, insects and birds, etc.?		✓	Not anticipated. The subproject will improve current practice of open dumping. SLF O&M manual will include mitigation measures to control insects, vectors, etc.
• Health and safety hazards to workers from toxic gases and hazardous materials in the site?		✓	Not anticipated. Workers health and safety, specifically the use of personal protective equipment and trainings, will be included in the SLF O&M manual.
• Disproportionate impacts on the poor, women and children, Indigenous Peoples or other vulnerable groups?		✓	Not applicable. There are no human settlements within 4 km radius of the SLF site.
• Risks and vulnerabilities related occupational health and safety due to physical, chemical, biological, and radiological hazards during project construction and operation?		✓	Not anticipated. Workers health and safety, specifically the use of personal protective equipment and trainings, will be included in the SLF O&M manual.
• Large population influx during project construction and operation that causes increased burden on social infrastructure		✓	Not anticipated. The contractor will be encouraged to hire local workers from the local labor force. Improved management

Screening Questions	Yes	No	Remarks
and services (such as water supply and sanitation systems)?			systems through capacity building and institutional development will ensure reduced burden on services and infrastructure.
• Risks to community health and safety due to the transport, storage, and use and/or disposal of materials such as explosives, fuel and other chemicals during construction and operation?		✓	Not applicable. Construction will not involve use of explosives and chemicals. Excavations will be done manually. Operations will not involve use of chemicals
• Community safety risks due to both accidental and natural hazards, especially where the structural elements or components (e.g., landfill or incinerator) of the project are accessible to members of the affected community or where their failure could result in injury to the community throughout project construction, operation and decommissioning?		✓	Operational area will be clearly demarcated and it will be controlled access. Only worker and project concerned member with proper PPE will be allowed to visit the operational sites.

Screening Questions		Score	Remarks[6]
Location and Design of project	Is siting and/or routing of the project (or its components) likely to be affected by climate conditions including extreme weather related events such as floods, droughts, storms, landslides?	0	SLF location is not in flood plains etc.
	Would the project design (e.g. the clearance for bridges) need to consider any hydro-meteorological parameters (e.g., sea-level, peak river flow, reliable water level, peak wind speed etc.)?	0	SLF leachate and treatment systems are designed to handle peak flow demands.
Materials and Maintenance	Would weather, current and likely future climate conditions (e.g. prevailing humidity level, temperature contrast between hot summer days and cold winter days, exposure to wind and humidity hydro-meteorological parameters likely affect the selection of project inputs over the life of project outputs (e.g. construction material)?	0	No significant effect
	Would weather, current and likely future climate conditions, and related extreme events likely affect the maintenance (scheduling and cost) of project output(s)?	0	No significant effect
Performance of project outputs	Would weather/climate conditions and related extreme events likely affect the performance (e.g. annual power production) of project output(s) (e.g. hydro-power generation facilities) throughout their design life time?	0	No significant effect

Options for answers and corresponding score are provided below:

[6] If possible, provide details on the sensitivity of project components to climate conditions, such as how climate parameters are considered in design standards for infrastructure components, how changes in key climate parameters and sea level might affect the siting/routing of project, the selection of construction material and/or scheduling, performances and/or the maintenance cost/scheduling of project outputs.

Response	Score
Not Likely	0
Likely	1
Very Likely	2

Appendix 8: Records of Public Consultation with Photo Graph

No	Type of Consultation	Stakeholder	LC Area	Venue	No of participants	Date	Time	Duration
COMMUNITY								
1	Focus group Discussion (FGD)	Community	Govt. complex Luangmual	V.C Hall	28	28.4.2014	19:00	120 mins
2	FGD	Sanitary inspector from AMC and UD&PAD	Aizawl	SIPMIU office	10	17.6.2014	13:00	90 mins
3	FGD	LC, YMA, MHIP & MUP members	Laipuitlang	Residence of LC Chairman	15	30.6.2014	11:00	120 mins
4	FGD	Community	College Veng	YMA hall	42	10.7.2014	19:00	180 mins
5	FGD	Community	Nursery Veng	V.C Hall	44	17.7.2014	19:30	180 mins
6	FGD	Community	Chawnpui	Chawnpui Sport Centre	71	31.07.2014	19:30	180 mins
7	FGD	Community	Kanan	Kanan multipurpose Hall	150	1.08.2014	19:30	180 mins
8	FGD	Sanitation workers of the area	Kanan	Residence of LC Chairman	16	5.09.2014	19:30	60 mins
9	FGD	Sanitation workers of the area	Nursery	V.C Hall	18	6.09.2014	10:00	60 mins
10	FGD	Sanitation workers of the area	Chawnpui	MHIP house	16	11.09.2014	15:00	60 mins
11	FGD	Sanitation workers of the area	College Veng	Residence of LC Chairman	17	12.09.2014	15:00	60 mins

Training session in college veng for solid waste resource management


Chawnpui SWM Awareness campaign


govt. complex SWM awareness campaign

Tuikual awareness programme on health, sanitation, risk upon disaster housing and solid waste management

AGREEMENT

Today, on the 31st of January 2013, a Meeting on Solid Waste Management under the Project Director Office SIPMIU (NERCCDIP) was held at YMA Committee Room, Zemabawk. On behalf of the people of AMC, Ward No. VII, Zemabawk Localities we do hereby declare that, we do not have any ocjection in the process of implementing the Solid Waste Management Sub Project including the development of a new Sanitary Landfill at Zemabawk locality and hereby give our full co-operation.

Vawiin ni 31 January, 2013 hian Solid Waste Management chungchangah Project Director Office SIPMIU (NERCCDIP) te nen Meeting YMA Committee Room, Zemabawkah kan nei a. Aizawl AMC Ward No. VII, Zemabawk mipuite aiawhin he Sub Project Solid Waste Management bakah Bawlhhlawh sawngbawlna hmun thar (new Sanitary Landfill) Zemabawk rama siam thar turah hian engmah sawi buaina kan neilo a, theihtawpin kan thlawp tlat a ni.

REPRESENTATIVE/KHAWTLANG AIAWH

Bakliana 31/1/13
(K.LALBIAKLIANA)
Member Secretary
Zemabawk Local Council
Aizawl

31/1/2013
(DAVIDA)
Chairman
Zemabawk Local Council
Aizawl

31/01/2013
(LALRAMSANGA)
Secretary
Young Mizo Association
Zemabawk Branch

31/1/2013
(ZOCHHUANA)
President
Young Mizo Association
Zemabawk Branch

31/1/13
(ZANGURI)
Secretary
Mizo Hmeichhe Insiamkhawm Pawl
Branch : Zemabawk

31/1/13
(K.LALHMINGLIANI)

31/1/13
(SAINGURA SAILO)
Secretary
M U P
Zemabawk Unit

31/1/13
(CVL ROSANGA)
President
M U P
Zemabawk

31/1/13

APPENDIX 9: SAMPLE GRIEVANCE REDRESS FORM

(To be available in English and Mizo)

The _____Project welcomes complaints, suggestions, queries and comments regarding project implementation. We encourage persons with grievance to provide their name and contact information to enable us to get in touch with you for clarification and feedback.Should you choose to include your personal details but want that information to remain confidential, please inform us by writing/typing *(CONFIDENTIAL)* above your name. Thank you.

Date		Place of registration			
Contact Information/Personal Details					
Name		Gender	* Male * Female	Age	
Home Address					
Place					
Phone no.					
E-mail					
Complaint/Suggestion/Comment/Question Please provide the details (who, what, where and how) of your grievance below: If included as attachment/note/letter, please tick here:					
How do you want us to reach you for feedback or update on your comment/grievance?					

FOR OFFICIAL USE ONLY

Registered by: (Name of Official registering grievance)	
Mode of communication: Note/Letter E-mail Verbal/Telephonic	
Reviewed by: (Names/Positions of Official(s) reviewing grievance)	
Action Taken:	
Whether Action Taken Disclosed:	Yes No
Means of Disclosure:	

Appendix 10: Suggested Outline for the Landfill Operations and Maintenance Manual

I. Introduction

II. Purpose of the Manual
- A. Purpose and Scope of the Manual
- B. Limitations
  - i. Owner's Responsibility
  - ii. Operator's Responsibility
- C. Organizational Structure

III. Landfill Design and Operation
- A. General
- B. Basis of Design
  - i. Master Design
    - a. Description of Facilities
    - b. Landfill Containment System
    - c. Final Cover Design
  - ii. Cell and Liner Construction
  - iii. Monitoring Systems
    - a. Groundwater Monitoring
    - b. Landfill Gas Monitoring
    - c. Surface Water Monitoring (Effluent and Receiving Body)
- C. Operations Plan
  - i. Landfill Phasing and Life
  - ii. Landfill Operations
    - a. Basic Landfill Operation
      1. Initial Load Inspection
      2. Refuse Unloading
      3. Spreading of Refuse
      4. Refuse Compaction
      5. Refuse Lift and Daily Cover
      6. Interim (Intermediate) Cover
      7. Final Cover
    - b. Basic Landfill Equipment
      1. Spreading of Refuse
      2. Refuse Compaction
      3. Landfill Cover
    - c. Equipment Maintenance
    - d. Wet Weather Operations
      1. Access to Working Area
      2. Wet Weather Tipping Pads
    - e. Grade Control
      1. General
      2. Landfill Survey Staking
      3. Periodic Topographic Surveying
      4. Volume Calculations
- D. Landfill Closure and Post-Closure
  - i. Closure Plan
  - ii. Closure Procedures
  - iii. Post-Closure Maintenance and Monitoring

IV. Environmental Control and Mitigation
- A. Leachate Control
  - i. Leachate Removal
  - ii. Leachate Storage
  - iii. Leachate Recirculation/Treatment
- B. Dust Control
  - i. Dust Control Within the Landfill Footprint (Active Areas)
  - ii. Dust Control Outside the Landfill Footprint
  - iii. Using Leachate for Dust Control
- C. Litter Control
  - i. Litter Fence
  - ii. Other
- D. Vector Control
  - i. Rodent Control
  - ii. Fly Control
- E. Odor Control
  - i. Odor from Incoming Refuse
  - ii. Odor from In-place Refuse
  - iii. Odor from Leachate Tank
- F. Noise Abatement
- G. Bird Control
  - i. Cover Soil Placement
  - ii. Monofilament Line Shield
  - iii. Anti-Perch Strips
  - iv. Predator Decoys
  - v. Acoustic Controls
- H. Other Controls
  - i. Erosion Control
    1. Slope Damage
    2. Exposed Garbage
    3. Downstream Sedimentation
- I. Periodic Routine Inspections

V. Emergency Management
- A. Types of Emergencies
- B. Emergency Management and Contingency Plan
- C. Emergency Response
  - i. Unauthorized Loads
  - ii. Hazardous, Toxic, and Infectious Wastes
  - iii. Spills
  - iv. Fire
  - v. Earthquake
  - vi. Inclement Weather
  - vii. Other Emergencies

VI. Environmental Monitoring and Inspection
- A. Groundwater Monitoring
  - i. Sampling and Analysis – Procedures, Parameters, and Frequency
  - ii. Monitoring Well Inspection
- B. Leachate Monitoring
  - i. Leachate Sump Level Monitoring

- ii. Leachate Storage Tank Monitoring
- iii. Leachate Discharge Sampling and Analysis – Procedures, Parameters, and Frequency

C. Surface Water Monitoring (Effluent and Receiving Body)
- i. Sampling and Analysis – Procedures, Parameters, and Frequency

D. Gas Monitoring
- i. Landfill Perimeter Probe Monitoring
- ii. Confined Spaces

C. Other Monitoring

VII. Landfill Safety Procedures

A. Site Specific Procedures
- i. Fire and Explosion Prevention
- ii. Unauthorized Loads
- iii. Toxic and Hazardous Waste Exposures
- iv. Hazardous Material Handling
- v. Employee Health and Safety
- vi. Baseline Health Monitoring
- vii. Routine Health Monitoring

VIII. Annexes and Other Relevant Information

A. Master Plan Drawings

B. Environmental Quality Standards

C. Monitoring Checklists

Appendix 11 :(A) Declaration of AMC about Proposed Incineration unit at operational Dumping Site

No. D.21019/1/2014 - AMC
AIZAWL MUNICIPAL COUNCIL
Aizawl: Mizoram
*****

Dated Aizawl, the 13th February, 2015

To,

The Project Director,
State Investment Program Management & Investment Unit (SIPMIU),
Government of Mizoram.

Subject: Under Construction Incineration Unit at Aizawl Municipal Council Solid Waste Management Centre at Tuirial

Sir,

With reference to the subject cited above, I am to inform you that under construction Incineration unit at Aizawl Municipal Council Solid Waste Management Centre at Tuirial having the capacity of 1 ton per day is for incineration of Bio-Medical waste generated in Aizawl Municipal Council area.

Yours faithfully,

(JAMES LALNUNMAWIA)
Secretary
Aizawl Municipal Council

Phone No: 0389-2352090 (EPABX)/2350100/2352089/2350247 Fax: 0389-2350246
Website: amc.mizoram.gov.in Email: amcmizoram@gmail.com

Appendix 11 (B): Declaration of AMC about Future Planning of Operational dumping Site after Capping

No. M. 14013/1/2014 - AMC
AIZAWL MUNICIPAL COUNCIL
Aizawl: Mizoram
*****

Dated Aizawl, the 13th February, 2015

To,

The Project Director,
State Investment Program Management & Investment Unit (SIPMIU),
Government of Mizoram.

Subject: Future Plan for Aizawl Municipal Council Solid Waste Management Centre at Tuirial

Sir,

With reference to the subject cited above, I am to inform you that Aizawl Municipal Council Solid Waste Management Centre at Tuirial after capping will be utilized as a public premises.

This is for your kind information.

Yours faithfully,

(JAMES LALNUNMAWIA)
Secretary
Aizawl Municipal Council

Phone No: 0389-2352090 (EPABX)/2350100/2352089/2350247 Fax: 0389-2350246
Website: amc.mizoram.gov.in Email: amcmizoram@gmail.com

Appendix 11 (C): Letter of AMC about Date of Completion & Operation

AIZAWL MUNICIPAL COUNCIL
Ṭhuampui, Aizawl - 796017

No. M. 14022/1/2014 — AMC
Dated Aizawl, the 16th April, 2015

To,

The Project Director
SIPMIU, Aizawl
Mizoram

Subj: **Under Construction Incineration Unit at Tuirial Waste Dumping Site.**
Ref. No. W.11020/6/2008-PD/SIPMIU (NERCCDIP)/30 Date 30.3.2015

Sir,

With reference to the subject and letter above, I am to inform that under construction incineration Unit at Tuirial Waste Dumping Site will be completed within May, 2015 (Targeted) which is likely to be operational w.e.f June, 2015.

The CPCB Environmental Quality Monitoring Standards for waste incineration under Municipal Solid Waste Rule, 2000 & Biomedical Waste (*Management & Handling*) Rule 1998 are adopted for the monitoring system of the under constructed incineration unit.

For untreated waste storage and disposal of end or by product Aizawl Municipal Council temporally construct a storage garage and fill cell at present Tuiral Dump site, which is purely on trial basis.

This is for your kind information.

Yours Faithfully

16.4.15

(M. ZOHMINGTHANGI)
Chief Executive Officer
Aizawl Municipal Council.

Appendix 12: Grievance's Redressal Committee (State Level & City Level)

.G ENT OF MIZORAM
URBAN DEVELOPMENT & POVERTY ALLEVIATION
DEPARTMENT
*****

77

NOTIFICATION

Dated Aizawl, the 4th April, 2011.

No. B-11029/17/2009-UD&PA(ADB) : The Governor of Mizoram is pleased to constitute the following Committee for the State Investment Programme Management and Implementation Unit (North Eastern Region Capital Cities Development Implementation Programme) as follows with immediate effect and until further order :

Grievances Redressal Committee at State Level ;

1. Minister, UD&PA Department, Mizoram - Chairman
2. Deputy Commissioner, Aizawl District - Convener
3. Secretary, UD&PA, Govt. of Mizoram - Member
4. Secretary, Law & Judicial Department, Govt. of Mizoram - Member
5. Chief Executive Officer, Aizawl Municipal Council - Member
6. Project Director, SIPMIU, Aizawl, Mizoram - Member

Sd/- R.L RINAWMA
Secretary to the Govt. of Mizoram
Urban Development & Poverty Alleviation Department.

Memo No. B-11029/17/2009-UD&PA(ADB) : Dated Aizawl, the 4th April, 2011.

Copy to :

1. Secretary to Governor, Mizoram.
2. P.S to Chief Minister, Mizoram.
3. P.S to Ministers/Speaker, Mizoram.
4. P.S to Parliamentary Secretary, UD&PA, Mizoram.
5. P.P.S to Chief Secretary, Govt. of Mizoram.
6. Deputy Commissioner, Aizawl District, Aizawl
7. Project Director, SIPMIU, Aizawl, Mizoram.
8. All members concerned.
9. Director, UD&PA, Mizoram, Aizawl
10. Guard file.

(VANLALFAKZUALA)
Under Secretary to the Govt. of Mizoram
Urban Development & Poverty Alleviation Department

Grievance redressal committee (city level)

GOVERNMENT OF MIZORAM
URBAN DEVELOPMENT & POVERTY ALLEVIATION DEPARTMENT
*****

NOTIFICATION

Dated Aizawl, the 4th April, 2011.

No. B-11029/17/2009-UD&PA(ADB) : The Governor of Mizoram is pleased to constitute Grievances Redressal Committee at City Level (Aizawl) for the State Investment Programme Management and Implementation Unit (North Eastern Region Capital Cities Development Implementation Programme) as follows with immediate effect and until further order :-

Grievances Redressal Committee at City Level (Aizawl) :

1	Deputy Commissioner, Aizawl District	- Chairman
2.	Chief Executive Officer, Aizawl Municipal Council	- Member
3.	Councillor/Chairman of Ward Committee of the concerned Ward (where the Grievances occurred)	- Member
4.	Chairman, concerned Local Council (where the Grievance has occurred)	- Member
5.	Chief Engineer, PHE Department	- Member
6.	Chief Engineer, PWD	- Member
7.	Director, UD&PA	- Member
8.	President, Central YMA	- Member
9.	President, MUP	- Member
10.	President, MHIP	- Member
11.	President, Mizoram Consumers Union	- Member
12.	Project Director, SIPMIU, Mizoram, Aizawl	- Convener

Sd/- R.L RINAWMA
Secretary to the Govt. of Mizoram
Urban Development & Poverty Alleviation Department.

Memo No. B-11029/17/2009-UD&PA(ADB) : **Dated Aizawl, the 4th April, 2011.**

Copy to :

1. Secretary to Governor, Mizoram.
2. P.S to Chief Minister, Mizoram.
3. P.S to Ministers/Speaker, Mizoram.
4. P.S to Parliamentary Secretary, UD&PA, Mizoram.
5. P.P.S to Chief Secretary, Govt. of Mizoram.
6. Deputy Commissioner, Aizawl District, Aizawl for information
7. Project Director, SIPMIU, Aizawl, Mizoram.
8. All members concerned.
9. Director, UD&PA, Mizoram, Aizawl.
10. Guard file.

Appendix 13: Pictures of Waste Collection, Transportation and Disposal Practices

12.1 Market waste dumped near the road.

12.2 Drainage & Nullah blocked by waste.

12.3 Garbage dumped near the habitation area

12.4 Waste are collected and handled without using any protective equipment.

12.5 Garbage vehicle are manually operated without PPE's and the garbage vehicle are not covered

12.6 Disposal Site at Tuirial

12.7 Burning of Waste is a common practice at Dumping ground

12.8 Scrap dealers packed and stocked the Recyclable waste.

12.9 Street sweeping are normally done in the morning employed by AMC.