Draft Initial Environmental Examination

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India: North–Eastern Region Capital Cities Development Investment Program (Tranche 3) – Aizawl Water Supply 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
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
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
LCC	—	Local Council Chairman

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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 is being implemented over a six year period beginning in 2010, and is being funded by a loan via the Multitranche Financing Facility (MFF) of the Asian Development Bank (ADB). Tranche 1 was approved in July 2009 and the second tranche (Tranche 2) was approved in December 2011. The executing agency (EA) is the Government of Tripura (GoT) Urban Development Department (UDD) and the implementing agency is the State-level Investment Program Management and Implementation Units (SIPMIU).

2. 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 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.

3. This draft Initial Environmental Examination (IEE) has been prepared for Aizwal Water Supply Subproject for funding under NERCCDIP Tranche 3 following the EARF and meeting the requirements of ADB SPS, 2009. The components of the subproject include Part A: (i) construction of 9 ground level reinforced cement concrete zonal tanks; (ii) rain water harvesting tank at Republic Veng playground; (iii) extension of feeder mains for new zones and develop areas (31.66 km); (iv) extension of distribution network (224.16 km) and (v) installation of 70 bulk flow meters. Part B – (i) detailed investigation and survey; (ii) land acquisition; (iii) construction of approach road; (iv) construction of intake works structure; (v) supply of machineries and equipment; (vi) construction of water treatment plant (WTP); (vii) construction of electrical substation; (viii) building works; (ix) construction of clear water reservoir; and (x) security fencing. An Environmental Management Plan (EMP) is proposed as part of this report 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 grievance redress mechanism. 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.

4. There are no protected areas, wetlands, mangroves, or estuarines in or near the subproject locations. Trees, vegetation (mostly shrubs and grasses), and animals are those commonly found in urban areas. The subproject locations are not located in or near any historically-, culturally-, archaeologically- or architecturally-significant or tourists area.

5. Potential negative impacts were identified in relation to design, construction, and operation of the infrastructure. A number of impacts and their significance have been reduced by amending the designs and considering the environmental criteria for subproject selection specified in the EARF thus no impacts were identified as being due to the project design or location. Key construction stage impacts identified and addressed in the IEE include: (i) loss of productive agricultural lands and conservation of topsoil; (ii) impacts on low-lying areas and water bodies where protection measures are required to minimize impacts on water quality, disposal of wastes/debris in the water bodies, and potential disruption of flows; (iii) air, noise, and vibration impacts due to construction vehicles, equipment, and machinery in the vicinity of construction site and inhabited sections, in addition to dust control during construction activities;

impacts on the river courses and the water quality during the construction of the transmission mains across the smaller streams ; (v) management of spoil disposal due to the excavation for the transmission mains; (vi) safety measures during construction, including traffic diversions; (vii) management of sites temporarily used for construction activities, including borrow areas, construction camps, etc., and rehabilitation of the sites after completion of temporary use; and (viii) impacts on community health and safety hazards posed to the public, specifically in inhabited areas. In addition to these measures, environmental measures to be implemented as part of good engineering practices during construction are laid down in the IEE.

6. Once the system is operating, most facilities (deep tube wells and pipelines) will operate with routine maintenance, which should not affect the environment. Potential impacts due to operation of the WTP include competing uses due to water abstraction, solid waste such as sludge and residuals that may be generated during operations and maintenance activities, filter backwash that may contain suspended solids and organics from the raw water, high levels of dissolved solids, heavy metals, etc. and risks to workers due to use of chemicals for coagulation, disinfection, and water conditioning. The subproject will include development of O&M manuals which includes occupational health and safety. Therefore anticipated environmental impacts are mainly related to the construction period which can be minimized by the mitigating measures and environmentally-sound engineering and construction practices. O&M impacts can be avoided by ensuring operators are qualified and experienced, complying with national and state regulations, and implementing mitigation measures per O&M manual.

7. An impact of improved water supply system is increased generation of domestic wastewater. Aizawl will improve its current collection and treatment of septage thru another subproject to be financed by NERCCDIP Tranche 3. Therefore this subproject will have positive impacts to the citizens of Aizawl as they will be provided with a constant supply of water resulting to improved quality of life.

8. The stakeholders were involved in developing the IEE through face-to-face discussions and public meetings organized by SIPMIU. Views expressed were incorporated into the IEE and the subproject planning and development. Relevant information will be disclosed to stakeholders in language and form understandable to them and to a wider audience via ADB website. The consultation process will be continued and expanded during subproject implementation to ensure that stakeholders are fully engaged in the project, have the opportunity to participate in its development and implementation, and made aware of the project grievance redress mechanism.

9. The EMP includes mitigation measures intended to protect the environment, workers and community and will form part of the civil works contract. Its implementation will be assured by an environmental monitoring program. SIPMIU, with the assistance of design, supervision and monitoring consultants (DSMC) will monitor and measure the progress of EMP implementation thru observations on- and off-site, document checks, and interviews with workers and beneficiaries. Indicative EMP implementation cost includes budget to cover updating the IEE, preparing and submitting semi-annual reports, consultations and disclosure, application for environmental clearance/s, NOCs, CFEs, and CFOs and monitoring of EMP implementation. The cost of mitigation measures and surveys during construction stage will be incorporated into the contractor’s costs. SIPMIU will communicate with ADB regarding environmental safeguard issues. EMP implementation reporting to ADB will be done on a semi-annual basis.

10. Therefore the subproject is unlikely to cause significant adverse impacts as the potential environmental impacts associated with design, construction, and operation can be mitigated to standard levels without difficulty. 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.

I. INTRODUCTION

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 is being implemented over a six year period beginning in 2010, and is being funded by a loan via the Multitranche Financing Facility (MFF) of the Asian Development Bank (ADB). Tranche 1 was approved in July 2009 and the second tranche (Tranche 2) was approved in December 2011. The executing agency (EA) is the Government of Tripura (GoT) Urban Development Department (UDD) and the implementing agency is the State-level Investment Program Management and Implementation Units (SIPMIU).

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II. POLICY AND LEGAL FRAMEWORK

A. ADB Policy

4. 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.

5. **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 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.

6. **Environmental Management Plan**. An EMP which addresses the potential impacts and risks identified by the environmental assessment already prepared for tranche-2 will be followed with few inclusions of requirement learned during execution time. 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.

7. **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.

B. National Laws

1. EIA Notification (2006)

8. 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.

9. Category A projects requires 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 a comprehensive Terms of Reference (TOR) for the EIA study, which are finalized within 60 days. Upon 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.

10. 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 the 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.

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

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

12. 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 from the State Pollution Control Board before starting implementation and Consent to Operate (CTO) before commissioning. The annual renewal of the CTO is based on the performance of the facility and its compliance with the discharge standards. The Water Act also requires the occupier of such subprojects to take measures for abating the possible pollution of receiving water bodies.

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

13. The sub-projects 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 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.

4. Forest Legislation

14. Forest legislation in India dates back to the 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. The Act also allows Government control over forest and lands not being the property of Government.

15. 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.

16. GoI 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 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.

17. 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.

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

19. The following Consents, NOCs & Authorization are obtained for water supply & Sewerage Sub – Projects and attach as appendix , which summarized in the **Table – 1**

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

	Authorization, Consents & NOCs	Issued by	Date of Issue	Remarks
1.	Tree felling permission for WTP & Approach Road	Principal Chief Conservator of Forest Mizoram	Not Available	Tree Counting & Marking for felling is in progress
2.	Consent for Establishment of WTP	Member Secretary Mizoram state pollution Board	No.H.88088\poltn\9(238) 2015 – MPCB\111 dated 16th April 2015	A copy of Consent to establish is attached in appendix 3
3.	NOC for construction of Water Reservoir on donated Land at Tuivamit.	Agreement between the owner and SIPMIU	13th Feb 2015	A copy of NOCs is attached in appendix 5

III. DESCRIPTION OF THE SUBPROJECT

A. Type, Category and Need

20. **Type**. In continuance to Tranche 2 subproject, Tranche 3 sub project is proposed. This is a water supply subproject intended to improve the current situation in Aizawl in terms of improving the water supply and distribution system.

21. **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.

22. **Need.** The total availability of water from the existing sources is 34.80 MLD and even after commissioning of Trench 2 projects, the total water supply availability of water would be same and the per capita water supply would be about 75 lpcd. At present the city is covered with water supply distribution network to the extent of 54 % and would be increased to about

70% after commission of Trench 2 proposal. It therefore necessary to augment water with 37 MLD in order to meet the deficit in the intermediate stage (2033 AD) and strengthen the distribution system for covering 100 % population. Water Supply improvement works comprises of rehabilitation and replacement of existing old \ undersized GI pipe distribution networks laid about 30 years back , extension of new pipe lines in new area, new reservoirs , augmentation of water supply from river Tlawng at about 20 km away from the city and 9.5 km away from the existing intake well. The sub project is prepared to cover 100 % area of the AMC at supply level of 135 lpcd up to intermediate stage.

B. Location and Implementation Schedule

23. The subproject will cover the Greater Aizawl Planning Area (GAPA)[1] which covers a total land area of 128.91 square kilometers (km^2). GAPA includes Aizawl city and 82 local councils. Maximum subproject components will be located on government-owned land and existing right-of-way (ROW). One private land will be acquired for construction of GSR for which consultation with the land owner has been carried out.

24. Detailed design began in the third quarter of 2014. Construction will begin in last quarter of 2015 and will take around 42 months. All civil works will be completed by 2019. During the preparation of this report dates mentioned are only tentative.

C. Description of the Subproject

1. Existing Water Supply System

25. **Management.** The Aizawl Municipal Council (AMC) is established and functioning to manage municipal services. However, the Mizoram Public Health Engineering Department (PHED) has been mandated to manage the water supply in Aizawl.

26. **Source.** The water supply source is the Tlawng River, located about 12 km away from the city. The lift involved in pumping from the source to the topmost balancing storage reservoir is more than 1 km hence energy cost involved is very high and forms a major part of the operating and maintenance expenditure. Although dedicated power supply for pumping water is being installed at Dihmunzawl under tranche – 2, the completion is expected to increase the amount of water pump daily.

27. **Distribution.** The Greater Aizawl Water Supply Project was planned since 1983 and executed in phased manner. Phase – I aimed at a production of 10.8 million liters per day (MLD) for a population of 80,000. By the time the project was completed, the population had already exceeded the designed capacity. Phase – II was designed for a population strength of 300,000 and with a supply capacity of 24 MLD covering the Phase-I area and fringe areas of the city. It has been executed in two parts and completed in 2007. Part-1 was commissioned in 2007 for the capacity of 12 MLD and Part-2 was also trialled in 2008 for the remaining 12 MLD capacity.However, there will still be a gap for improving the supply.

28. There are problems with the distribution of the water supply in the city. Due to very uneven terrain on hilly area and very high heads involved in the system (150 m to 300 m) consumers can be supplied water only to the extent of few hours in a week. After the completion

of tranche – 1 there has been an increase of about 27% in the total storage capacity. There will be further increase after the completion of tranche – 2 and tranche - 3. Zoning has been initiated in tranche – 2 and is yet to be adopted in the system.

29. Most of the distribution lines are metallic[2] and as far as the consumer lines are concerned they are 20 millimeters (mm) diameter and above. As the system is getting older, the leakages and losses in the system are increasing and anticipated losses have been assessed to the tune of 50%.

30. Under the Tranches 1 and 2, two chlorinators and two booster pumps were installed. The system of supply through main reservoir – zonal reservoirs – supply tanks has been changed to some extent. Although there are frictional losses in the consumer's long service lines, which are a cause of low pressures. There are high leakage losses through these very service lines as well as supply tanks. On one hand, these high losses are resulting in lesser supply at the consumer end, while on the other hand water lifted to more than a km height is lost without use. What is required is that the distribution system has to be fed directly from the zonal reservoirs and distribution lines need to be extended without proper design in every lane, to cover all the households due to demand basis. The distribution system cannot function with dead ends and has to be converted in to loops, which are to be fed from the reservoir of proper elevation so as to achieve minimum of 12 m terminal head at the last end of distribution network by way of pressure zoning. Besides, distribution networks need to be extended to areas which are not presently covered by present supply network.

31. **Storage.** Storages are adequate as per norms but the system has to face very large falls and hence the storage runs down in a very short time. To control the water forcing the lower areas, valves are controlled. This exerts heavy pressures in the system and leakages increase. Velocities are very high in the system and hence, on controlling the valves return surges do occur.

32. **Metering.** Meters also go out of order due to system pressures. Repairing of the system in the very congested areas takes time and the supply is affected. Pipe lines are laid on the stringent slopes and curves. In case of higher diameter pipes, the joints in the pressurized condition leak. Connections from the system are taken in the form of bunched "T"s from the main pipeline. This leads to the situation of giving number of connections from the same point.

33. **Rain Water Harvesting.** Rain water harvesting method can be traced way back even before the introduction of water supply system. Almost every house were designed in a way to collect rain water from the roof since it was the available source other than perennial source and streams (so called tuikhur in local terms). At present two locations within GAPA have been identified practicing the system for internal use – one at Aizawl Theological College Durtlang and the other Presbyterian Hospital Durtlang. No location within GAPA practices rain water harvesting system for public use.

2. Subproject Components

34. The proposed improvement in the water supply system will involve: Part A: (i) construction of 9 ground level reinforced cement concrete zonal tanks; (ii) rain water harvesting tank at Republic Veng playground; (iii) extension of feeder mains for new zones and develop

[2] Galvanized iron (GI) pipes have been used for more than 20 years for house connections and for the distribution network. They are likely to be rusted.

areas (31.66 km); (iv) extension of distribution network (224.16 km) and (v) installation of 70 bulk flow meters. Part B – (i) detailed investigation and survey; (ii) land acquisition; (iii) construction of approach road; (iv) construction of intake works structure; (v) supply of machineries and equipment; (vi) construction of water treatment plant (WTP); (vii) construction of electrical substation; (viii) building works; (ix) construction of clear water reservoir; and (x) security fencing.

35. The objective of the improvement in water supply system is to provide equitable distribution over the city area. The quantity of water supplied to the city from the existing PHE water supply phase – II is not adequate with the booming population. Also the problem of distribution of water on the uneven slopes of the town. Thus, the subproject will:

(i) provide for the facility of rehabilitating the existing distribution and feeder mains. If required they will be replaced;
(ii) reduce unaccounted-for-water;
(iii) ensure power for the pumping of water from the head works and treatment plant;
(iv) get rid of T junctions;
(v) increase coverage and revenue by extending the system to the maximum possible extent; and
(vi) to augment the existing water supply system.

36. Details of the subproject components are provided in **Table 2**. 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.

Table 2: Aizawl Water Supply Subproject Components

Component	Location	Function	Description	Remarks
Part A: Improvement of Water Supply System				
1. Construction of Service Reservoirs	9 locations in GAPA	Storage of water prior to distribution	9 ground level reinforced concrete cement zonal tanks including fixing of Inlet, outlet and other pipes, its' commissioning and testing, land cost, site clearance etc.	One private land acquisition required. The remaining 8 locations are government land.
2. Rehabilitation and extension of existing feeder mains and coverage of new zones	Existing ROWs	Rehabilitate and extension of existing feeder mains upto the reservoirs.	Extension of main feeder pipe lines (31.66 km)	Land acquisition not required.
3. Extension to distribution networks.	Existing ROWs	Rehabilitate and expand distribution network	Extension of distribution system network (224.16 km)	Land acquisition not required.
4. Rain water harvesting	College veng playground.	Storage of water for public use	Provide rain water harvesting tank below playground and restoring to a better standard than the existing.	Land acquisition not required. Consent from the Sports council and local council have been obtained.
5. Installation of bulk flow meters	At reservoirs locations	Measuring amount of daily supply of	Purchase and installation	No physical interaction with the

Component	Location	Function	Description	Remarks
(43 nos)		water		environment
Part B: Water Supply Augmentation and Water Treatment Plant				
6. Detailed investigation and survey	Tanhril	Preparation for executing the project	Soil testing, water quality, intake site, pipe line and road alignment, pumping station and power transmission line, treatment plant etc	Only survey and testing. Hence there will be no impacts on environment.
7. Land Acquisition	Tanhril	For treatment plant, sub-station, transmission line, pump houses, approach road, reservoir etc	Once detailed survey and investigation is completed, all required land will be acquainted.	All acquired land is subjected to further environmental investigation.
8. Approach road to intake Treatment Plant, Pump houses & Pipeline	Tanhril	For transportation of equipments, machineries and pipes. Etc	Construction of new road will involve formation cutting, earthwork, filling, cross drainage, pavement work.	Subjected to further environmental investigation after finalization of the location.
9. Intake works structure	Tanhril,	Intake of raw water for pumping to water treatment plant	Construction of intake well, pumps house, electromechanical equipments and subsidiary piping arrangements to WTP.	Location will involve river bank execution. Hence necessary consent from concern authority will be obtained during finalization.
10. Supply of machineries and equipments	Project area	Supply	All equipments, pipes, machineries mentioned in DPR.	No physical interaction with the environment
11. Water Treatment Plant 37.0 MLD	Tanhril,	Treating of pumped water.	Construction of treatment plant, electrification etc	Consent to establish from Mizoram Pollution Control Board (MPCB) is in progress. **(APPENDIX 3)**
12. Electrical sub-station for raw water pumping station 1 and 2	Tanhril	Providing power 33 Kva for pumping.	33Kva power generated from Luangmual substation and construction of transmission line/tower and substation.	Required consent will be taken from concern authority.
13. Building works	Tanhril	Dg set room, office building, rest house, quarters	Construction	Subjected to further environmental investigation after finalization of the location.
14. Clear water Reservoir	Tanhril	Storage facility for treated water	Reservoir will be constructed where	Location subjected to further

Component	Location	Function	Description	Remarks
			treated water will be stored for further distribution	environmental investigation.
15. Security Fencing with RCC column and brick wall	Tanhril,	Provide boundary wall for safety/security	Brickwall with RCC column will be constructed to secure the WTP.	There will be No issue since the work will be taken up after LA is completed.
16. Provision for the IEC component	GAPA	to increase capacity and awareness level on water conservation and water supply system.	Consultation with public, stakeholders and organized trainings. Trainings for SIPMIU and DSMC personnel.	No physical interaction with the environment

37. **Proposed 37 MLD Water Treatment Plant:** The present WTP site at Dihmunzawl will accommodate the 24 MLD facilities. A new 37 MLD capacity WTP is proposed at Tanhril area to augment the existing water supply system. The plant will be designed for a continuous output of 37 MLD. The treatment plant will include prechlorination, coagulation, flocculation, sedimentation, filtration, and post-chlorination facilities. Recirculation of backwash water and dewatering of sludge are included. The following main components are proposed:

(i) Pre-chlorine, aluminum sulfate, lime, and polyelectrolyte dosing facilities for treatment;
(ii) Three lines of two rapid mixing chambers in series, each equipped with a mechanical rapid mixer;
(iii) Three lines of 2 x 2 flocculation chambers in series, each tank equipped with one mechanical flocculator;
(iv) Three lines of two plate settlers in parallel, each settler equipped with a scraper and desludging valves;
(v) Three lines of eight rapid sand filtration units in parallel of the deep sand bed type, including air and water backwash facilities and a backwash water storage tank;
(vi) Post-chlorination and lime solution dosing facilities;
(vii) Three contact time reservoirs in parallel;
(viii) Two common storage reservoirs in parallel; and
(ix) One treated water pumping station.
(x) Sludge from the sedimentation, after preliminary thickening in the sedimentation tanks themselves, will be pumped to sludge-drying beds for final disposal.
(xi) An oil & grease trap will be constructed for storage of spent oil & grease during maintenance of WTP.

Figure 1:Google Imaginary for Proposed Water Intake, WTP, Alignment for Water Pipeline & Approach Road and Cross – Drainage Structure for Trench – 3

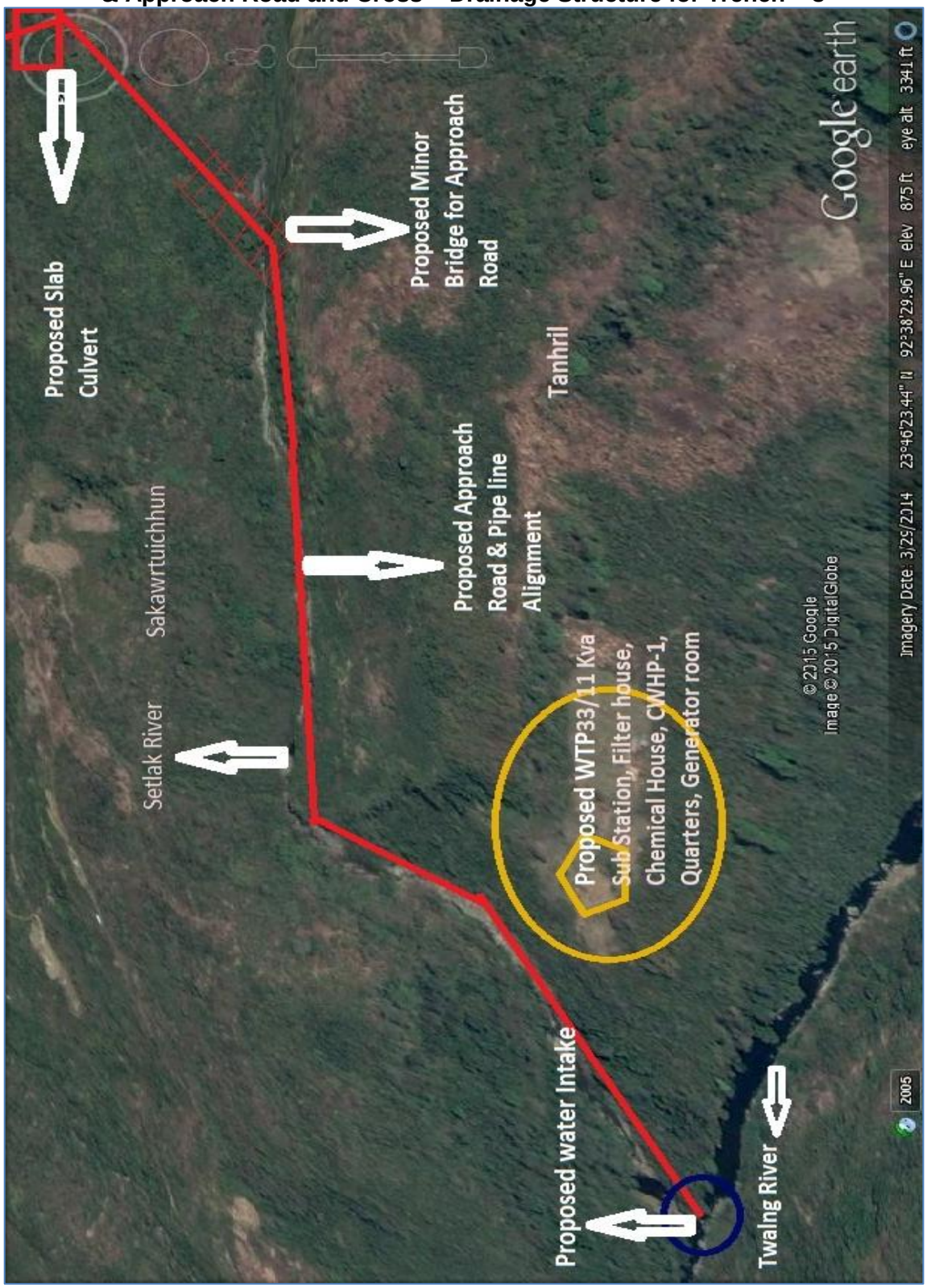


Figure 2: Google image depicting Tranche-3 reservoirs and feeder line. (Red line depicts ongoing feeder line, yellow box with yellow fonts depicts Tranche-3 GSR and white line depicts Tranche-3 feeder line. Green line depicts existing feeder line)

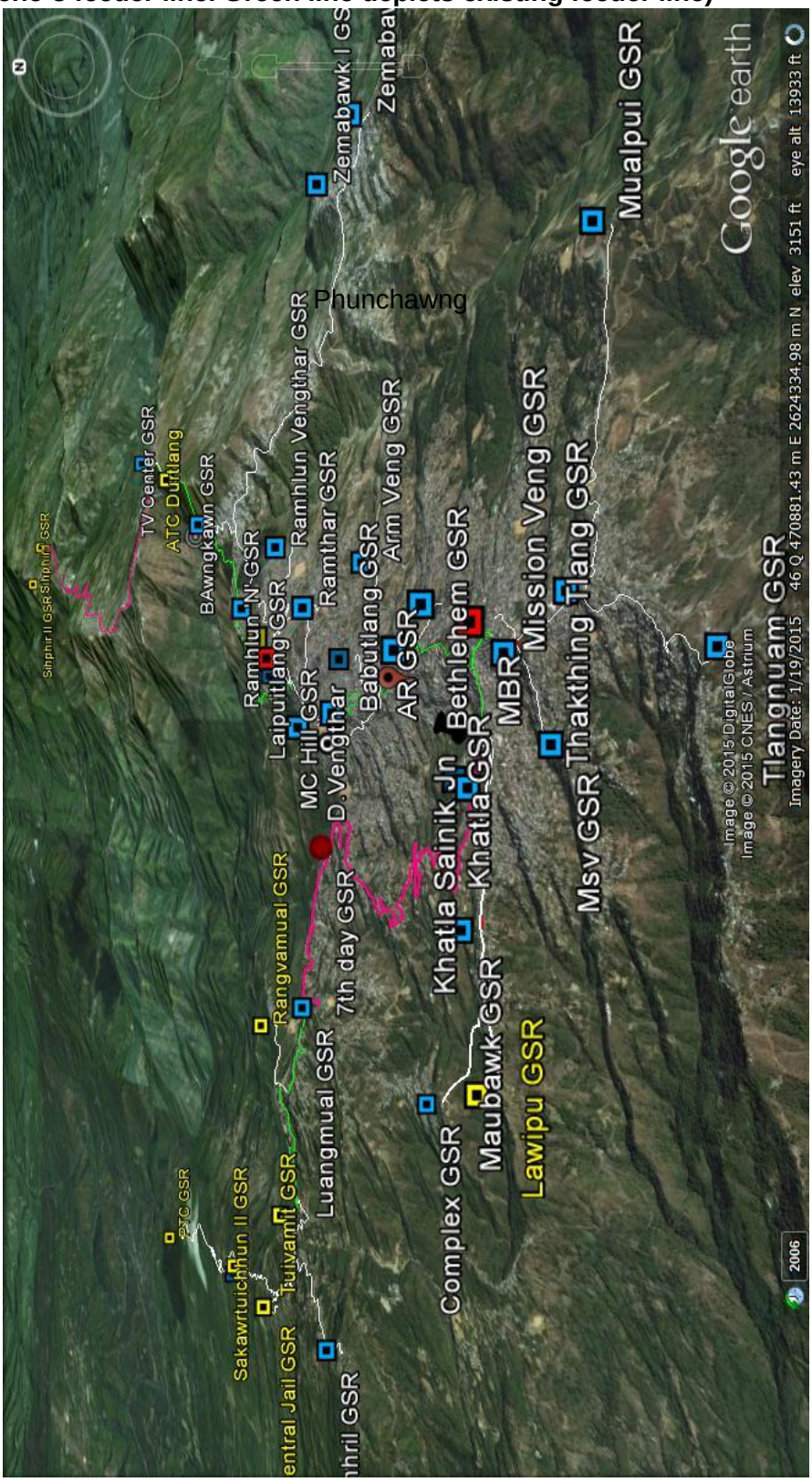


Figure 3: Schematic Diagram of WS System from Source to MBR

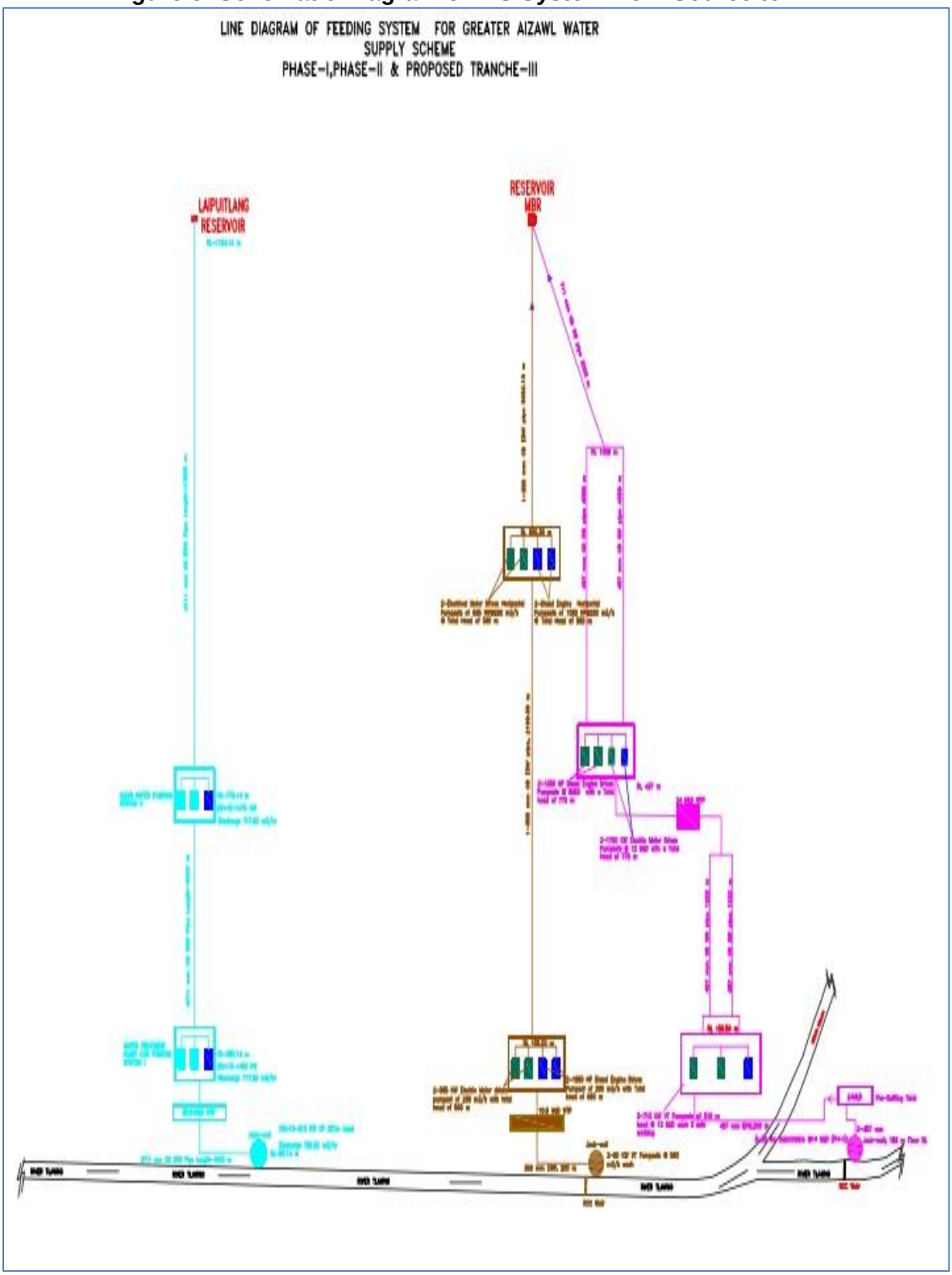


Figure 4: Line Diagram for WTP (37.0 MLD)

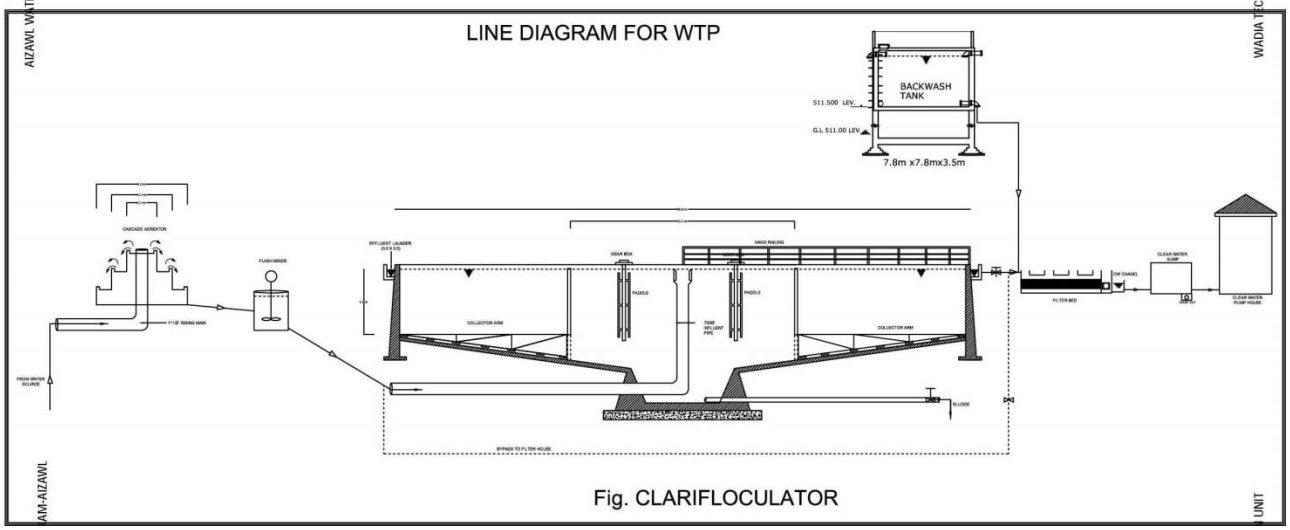
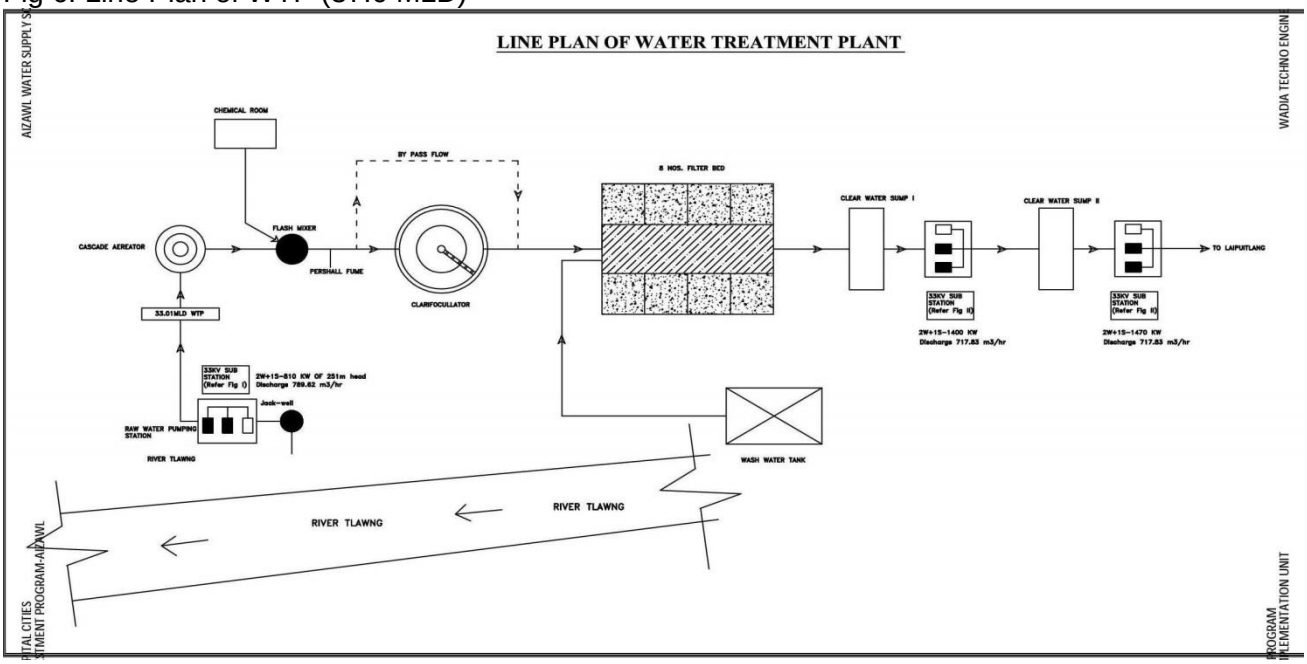


Fig 6: Line Plan of WTP (37.0 MLD)



IV. DESCRIPTION OF THE ENVIRONMENT

A. Physical Resources

1. Location and Administrative Boundaries

38. 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.

39. **Location – WTP Site.** The proposed WTP site is located at Tanhril, ranging about 20km distance from the city.

40. **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 6,560 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 meters 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.

41. **Topography – WTP Site.** Aizawl is situated in hilly environment hence availability of flat area is very rare. The site is situated in hilly terrain. The proposed site, although situated in hilly terrain, maintains adequate area of wider contours which will require relatively little grading work.

42. **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.

43. **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.

44. Subsidence is another problem encountered in Aizawl. Land subsidence and soil fissuring are 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.

45. **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 (geosynclinal) 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.

46. **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.

47. **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% to 70% and in the monsoon period is about 90%. During southwest monsoon, February to April is comparatively dry when humidity is between 60% to 70%.

48. **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).

49. **Air Quality – WTP Site.** As there are no major air pollution potential sources, the air quality of the WTP site is generally good.

50. **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.

51. **Noise Level – WTP Site.** The sub-project site is in an undeveloped area without any industry or commercial activity hence the noise level is normal.

52. **Surface Water.** The analysis of water quality of rivers within Greater Aizawl, namely the Tlawng 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.

Figure 5: Water Quality Monitoring Report during Feasibility Study

GOVERNMENT OF MIZORAM
STATE REFERRAL INSTITUTE
PUBLIC HEALTH ENGINEERING DEPARTMENT
AIZAWL

WATER ANALYSIS REPORT

Sample No.	: GS/2013-14/408
Name of Source	: Tlawng Raw Water
Detailed Location	: Tlawng Lui, Reiek Kai
Type of Source	: River Water
Sample collected by	: Patea, Tawna O.S-II
Sample Collected on	: 24.10.2013
Sample Received on	: 24.10.2013
Date of Analysis	: 28.10.2013
Name of R.D. Block	: Tlangnuam

	Results of Analysis	B.I.S. Specification for drinking IS-10500 : 2012	
		Requirement (Acceptable limit)	Permissible limit in the absence of alternate source.
1. Physical Characteristics			
1) pH	6.87	6.5 - 8.5	
2) Odour	Odourless	unobjectonable	-
3) Taste	Tasteless	agreeable	-
4) Colour	Colourless	unobjectonable	-
5) Turbidity (in NTU)	307.00	1.0	5.0
6) Electrical Conductivity (in micro mhos/cm)	107.0 at 21.8°C	500.0	
7) Total Dissolved Solids (in mg/l)	53.60	500.0	2000.0
2. Chemical Characteristics (in mg/l)			
1) P- Alkalinity	NIL	-	-
2) M.Alkalinity	80.0	-	-
3) Total Alkalinity	80.0	200.0	600.0
4) Total Chloride	23.0	250.0	1000.0
5) Total Hardness	48.0	300.0	600.0
6) Total Iron	0.3	0.3	0.3

Analysed by :
Sd/-
(LALCHHINGPUII)
Lab. Technician

Remarks: The level of Turbidity becomes too high.

28.10.13
(P.C. BIAKMAWIA)
Chief Chemist,
State Referral Institute
PHED, Mizoram

53. **Tlawang River:** Tlawng River is one of the most important and the longest river of Mizoram. It is navigable by small boat throughout the year and hence it provides water transport route with neighbouring state of Assam. Tlawng (also known as Dhaleswari) a tributary of the Barak at latitude 230 38' 13" and longitude 920 39' 10". The river Tlawng originates at an elevation of about 1070 m from the southern part of Mizoram state and flows from the south to north direction for a length of more than 100 km up to the project site. After traversing a distance of about 300 km, the river enters the Cachar region of Assam and joins river Barak. The river traverses with a moderate slope and several major tributaries such as Changte Lui, Lik lui, Hmawngva Lui Rivers join the Tlawng River in route. The catchment is about 23 km wide on an average and is fairly dense with vegetation (mainly Bamboo). The elevation in the catchment ranges from 1070 m in the upper reaches to around 130 m near the project site and the average

annual maximum discharge is about 448.35 MLD (183 cusec) (Post – Monsoon) (in year Nov.2000) at Up – stream side (Reiek Bridge) of the proposed Water Intake Site and minimum discharge is 262.15 MLD (107 cusec) (Pre – Monsoon) in March 1994 (source: Minor irrigation department Govt of Mizoram). The average minimum discharge of the river found to be more than 244. 6 MLD (Approx 100 cusec) as per study conducted by minor irrigation department from 1975 to 2000 AD where as the ultimate requirement for water supply project is 85.29 MLD as per projected demand of 2048, hence there is sufficient source reliability. Approved discharge details for 25 years are attached as an **Appendix 5.**

Figure 6: Tlawnag River on Mizoram Map (Source National Wetland Atlas) MOEF GOI

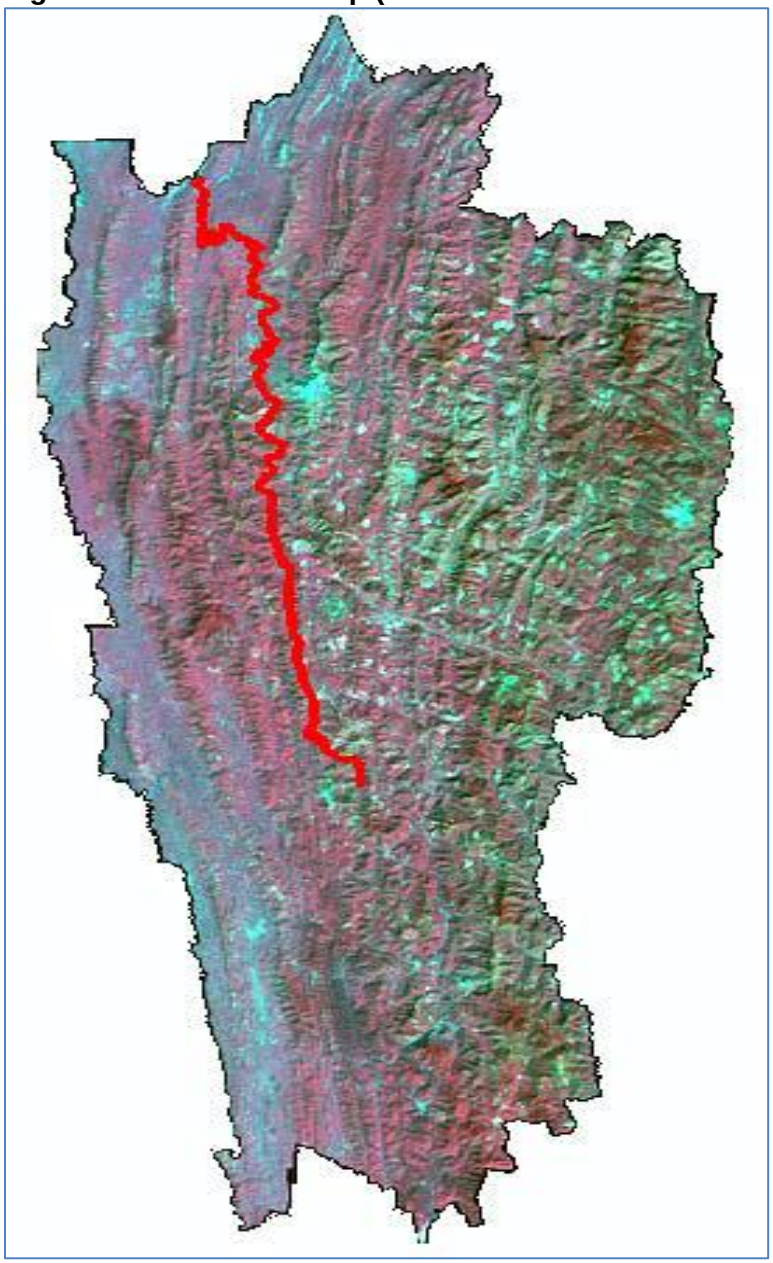
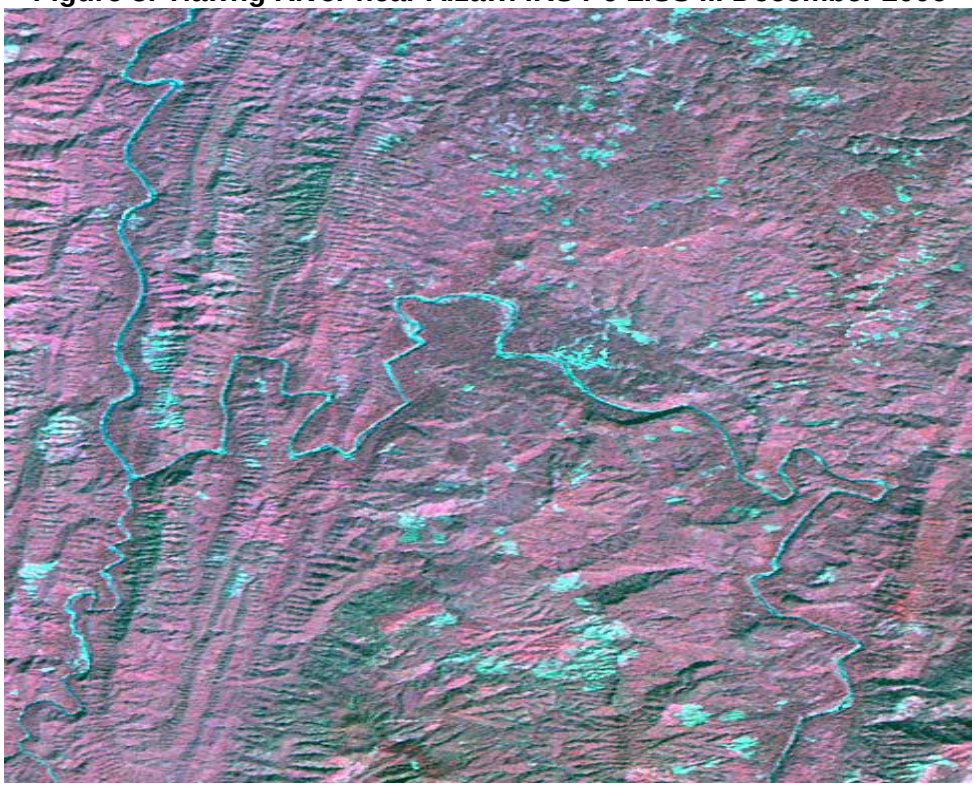


Figure 7: Tlawnag River with Catchment Area & Its Major Tributaries

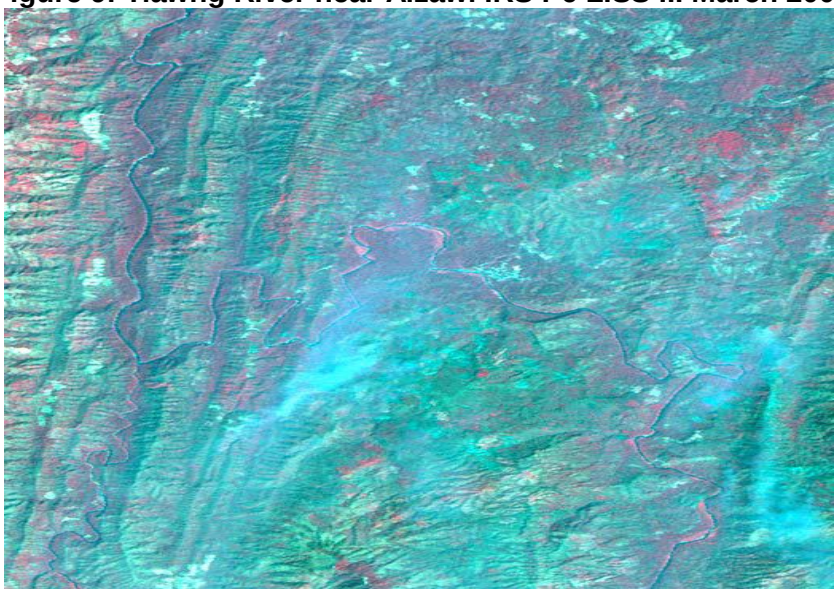
Source National Wetland Atlas) MOEF GOI

Figure 8: Tlawng River near Aizawl IRS P6 LISS III December 2006



Source National Wetland Atlas) MOEF GOI

Figure 9: Tlawng River near Aizawl IRS P6 LISS III March 2007



Source National Wetland Atlas) MOEF GOI

54. 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 liters to 330 liters per minute for draw down of 13 m to 20 m. While the quality of groundwater, 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]

B. Ecological Resources

55. 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 Greater Aizawl planning area boundaries.

56. 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 the 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.

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

57. **Ecological Resources – WTP Site.** Natural vegetation exists adjacent to the project site but no major trees have been observed within and around the site. There are no critical habitats adjacent to or within the vicinity of the proposed site.

C. Economic Development

58. **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.

59. **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 center 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.

60. Since 1972, mining and quarrying for building materials has been started within Aizawl city. As per the information from geology and mining wing on July 2001, 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.

61. **Infrastructure.** 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 lpcd and it is much less, perhaps as little as 50 lpcd 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 1,017 meters, from the riverbed level at 146 meters to the main storage reservoir at 1,163 meters, making it one of the most expensive water supply systems in India. However, after the completion of tranche – 2 works, the supply system will improve to some extent.

62. **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.

63. **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.

64. **Health Facilities.** The city has 16 hospitals out of which, 2 hospitals are run by the Presbyterian and Seventh Day Adventist Church and nine is a private hospital. Also, there are about 23 dispensaries and sub-health centers scattered all over the city.

65. **Slum Upgradation.** 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 economically backward area. RAY (Rajiv Gandhi Awaz Yojna) is being taken up by State Government under UD&PA Department (Urban Development & Poverty Alleivation) for Upgradation to the identified economically backward areas.

66. **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

67. **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 53.17%. 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 population 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.

68. Ninety eight percent of the population in Aizawl belongs to the scheduled tribes (STs). 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.

69. **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 slope is also another wonder for tourists. The beautiful churches usually painted in white colours in every localities is yet another wonder. Chapchar Kut the festival celebrated during the month of March is the most joyful festival of the Mizos, where young and energetic –men and women dressed in their colorful attires all poised to perform the colourful Cheraw dance and other cultural dances and is one of the biggest tourist attractions. There is no heritage building nor is there any property related to cultural activities in the surroundings of the proposed sanitary landfill site.

70. **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 neighboring 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. However, people living within the Aizawl city having urban outlook and do not exhibit any primitive or distinct characteristics of that are considered to be indigenous people.

V. ANTICIPATED IMPACTS AND MITIGATION MEASURES

71. 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 locations for laying of pipes, WTP and intake sites; (ii) main routes/intersections which will be traversed by construction vehicles; and (ii) 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.

72. The ADB Rapid Environmental Assessment Checklists for Water Supply http://www.adb.org/documents/guidelines/environmental_assessment/eaguidelines002.asp were used to screen the subproject for environmental impacts and to determine the scope of the IEE investigation. The completed Checklist is found in **Appendix 1** (Water Supply).

73. 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. The subproject will be in properties owned and/or acquired by the local government in the 8 reservoir locations (except 1 location will require LA). Pipeline installation work will disrupt access for a short period during construction. The WTP will require LA and further environmental examination once all required locations are finalized.

A. Pre-construction – Location and Design

74. **Location.** These Impacts are associated with planning particularly on the site selection. They include impacts due to encroaching on sensitive areas and impacts on the people who might lose their homes or livelihoods due to the development of the proposed site.

75. **Location of Water Treatment Plant Components.** Proposed WTP site is located in Tanhril which is a private land. This land will be required for construction of WTP which has been included in the subproject's Resettlement Plan. The present site has been considered because it is located in an area of: (i) at least 4 km (approx) from any inhabited areas; (ii) no risk of flooding or other hazards that might impair the functioning of the plant; and (iii) no risk of chance finds.

76. **Impacts on River Ecology.** Intake screens are to be designed according to the swimming characteristics of lotic fauna to ensure that the impacts on their habitat as well as the flora are minimized. Consulting a fisheries expert as part of the detailed design is proposed, to provide inputs on the design of the intake screen to minimize impacts on fish. Efforts to minimize such impacts will be integrated into the detailed designs by the fisheries expert.

(i) **Upstream Pollution Impacts and Protection of Source.** The water quality monitoring program carried out as part of the feasibility study confirmed that the key water quality parameters at the intake location are within permissible limits

for inland surface waters designated for use for water supply after conventional treatment. The current low levels of pollution can be attributed to the absence of any major pollution sources upstream along the Tlawng, coupled with dilution factors in the river system. Protection of the source through regulation of upstream developments, especially discharge of effluents (either untreated or partially treated), has been identified as a key policy level intervention requiring inter-departmental coordination. While consultations with the other line departments, such as the Department of Industries and the SPCB, do not indicate future large-scale industrial development upstream of the intake, enforcement of discharge standards and treatment of liquid wastes in populated clusters. Based on the analysis of the water quality results, the major sources of pollution, levels of dilution and responsible institutions shall be identified. In addition, a semi-annual field visit by the environmental officer of the SIPMU, along with the environmental specialist of the consultant team and the representative of the district office of the SPCB, to various locations within 50 km upstream of the intake shall be carried out. These visits shall enable identification and reporting to the SIPMU on any potential issues with respect to change in land uses, pollution sources, etc. The findings of the water quality analysis and the field visits, along with recommendations towards source protection, shall be summarized and presented as part of the semi-annual environmental monitoring reports

(ii) **Impacts on Down Stream Uses.** The proposed abstraction accounts for only a mean of the lean flow and maximum flow of river for design period. This minor level of abstraction is considered not to adversely impact downstream uses or ecological flows of the Tlawng River. Further, these levels of abstraction are not envisaged to result in any flow modifications, which can potentially lead to adverse intrusion or impacts on downstream water uses.4

77. **Design of the proposed components.** The subproject has been designed to meet the water demands in the year 2030 and 2045. It is proposed that the subproject be commissioned by the year 2019. The design was based on a population forecast and demand calculations for the mid-period, year 2030.

78. **Utilities.** Telephone lines, electric poles and wires, water lines within the proposed subproject locations may require to be shifted in few cases. To mitigate the adverse impacts due to relocation of the utilities, DSMC will (i) identify and include locations and operators of these utilities in the detailed design documents to prevent unnecessary disruption of services during construction phase; and (ii) require construction contractors to prepare a contingency plan to include actions to be done in case of unintentional interruption of services.

79. **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, DSMC/SIPMIU will:

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[4] The average annual maximum discharge is about 448.35 MLD (183 cusec) (Post – Monsoon) (in year Nov.2000) at Up – stream side (Reiek Bridge) of the proposed Water Intake Site and minimum discharge is 262.15 MLD (107 cusec) (Pre – Monsoon) in March 1994 (source: Minor irrigation department Govt of Mizoram). The average minimum discharge of the river found to be more than 244. 6 MLD (Approx 100 cusec) its only 16 % of average minimum flow.

(i) consult PHED 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 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.

80. **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.

81. **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 will 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 ULB. 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 PHED.

B. Construction

1. Screening of No Significant Impacts

82. The construction work is expected not to cause major negative impacts, mainly because:
(i) most of the activities will be on the built-up areas of Aizawl city and/or existing Rows thus could be constructed without causing impacts to biodiversity;
(ii) most of the sites are located on government-owned land which is not occupied or used for any other purpose;
(iii) the water treatment plant will be in an isolated area, therefore no major impacts is expected.
(iv) overall construction program will is expected to be completed in 42 months with activities to conducted by small teams and specified location so most impacts will be localized and short in duration; and
(v) 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.

83. 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 **Table 3**. These environmental factors are screened out presently but will be assessed again before starting the construction activities.

Table 3: 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 treatment 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

2. Construction Method

84. Although the site is not fairly large, the WTP construction will be straightforward involving mainly simple excavation. The reservoir tanks will be dug by backhoe diggers and mechanical excavator, and soil will be transferred into trucks for offsite disposal. The spoils will be disposed in disposal site designated by the AMC. Clay will then be applied to the floor and sloping sides of each tank and after watering will be covered with low density poly-ethylene (LDPE) sheeting and concreting in some parts. A thin layer of cement mortar is then added, and concrete tiles are embedded into the surface by hand, with more cement grouting applied to seal joints between tiles.

85. The cavity for the chlorination & sludge tank will be excavated by backhoe, with soil being loaded onto trucks for disposal or will be used in site development. Aggregate and concrete will be tipped into each void. A thin layer of cement mortar is then added, and concrete tiles are embedded into the surface by hand, with more cement grouting applied to seal joints between tiles. Surfaces will be smoothed and finished where necessary by hand.

86. Provision of primary network (feeder mains) and secondary water distribution network involve same kinds of construction. Pipes will be buried in trenches immediately adjacent to roads, in the unused area within the ROW, alongside the edge of the tarmac. In narrower roads, where this area is occupied by drains or the edges of shops and houses etc, the trenches will be dug into the edge of the road. Trenches will be mostly dug manually supplemented by back hoe

digger when required or feasible. The feeder mains will be located in the larger roads where there is generally sufficient space at the edge of the road that has not been encroached by structures. Excavated soil will be placed nearby, and the pipes (brought to site on trucks and stored on unused land nearby) will be placed in the trench manually. Pipes will be joined by hand, after which the trench will be refilled with excavated soil and compacted manually. Feeder mains at some stretches (such as in steep slopes) will be laid above the ground. Similarly secondary network in narrow and steep sloping lanes will be laid above the ground. In these stretches, work involves no earth work.

87. As noted above, some of the narrower roads are constructed of concrete and have no available space at the edge because of the presence of drains, or shop- and house-fronts encroaching into the ROW. In these places it may be necessary to break open the surface of the road using hand-held drills, after which the trench and pipeline will be constructed. On completion, a concrete or bituminous layer will be re-applied to the surface to repair the road.

88. The Service Reservoirs will be built on government land with exception of one which requires minor land acquisition of private land. The cavity for the Service Reservoirs will be excavated by backhoe, with soil being loaded onto trucks for disposal or will be used in site development. Aggregate and concrete will be tipped into each void to create the foundations and floor, after which metal reinforcing rods will be added to create the outline of the walls of the ground reservoir and the vertical supporting pillars of the overhead reservoir. Sections of reinforcing will then be encased in wooden shuttering and concrete will be poured in, and this process will be repeated to gradually create each structure from reinforce cement concrete (RCC), including the tank of the overhead reservoir and the above-ground portion of the ground reservoir. Surfaces will be smoothed and finished where necessary by hand.

89. The Rainwater Collection tank will be constructed as a RCC monolithic structure, shape following the configuration of the open field. The tank will have two chambers: one peripheral of width 1.5 m and the other a central one with RC Pillars supporting the top cover slab at spacing of 4.0 m in both directions. The tank cover will have a gentle slope around 0.6% from the centre to outer periphery. Rain water falling on the open surface will have both surface run off and body percolation. Both the types of Rain water will flow towards the edges, where a gutter of deign depth 1000 mm and width 1000 mm (Top covered with perforated gratings and fine wire mesh to prevent entry of plastic chips) will collect both the surface and the percolation run off through weep holes . Water from the gutter will lead to the peripheral chamber through side openings on the surface of outer wall of the tank. The water in the peripheral chamber will be stored first and then it will pass on to the inner chamber of the tank by flowing over a weir after precipitation of all the settle able suspended matters. There will be a wash out arrangement for removal and cleaning of all the debris and silt from the peripheral chamber. The storage tank will be provided with necessary ventilation & illumination arrangements along with provision of measurement and maintenance. A free board of 300 mm will be provided over the highest water level. The stored Rain water from the inner chamber will be used by the water management authority during rainy period and lean period and in case of crisis. It is proposed to use the stored water only after proper treatment i.e.by Pressure Filter unit followed by Disinfection process.

90. Although construction of the subproject components involves quite simple techniques of civil work, the invasive nature of excavation in the subproject locations will result to impacts on environment and sensitive receptors such as residents, businesses, and the community 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; (ii) any excavation done near sensitive area like school, religious places and house will be protected as per standard norms[5].

91. **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 State Investment Program Management & Implementation Unit (SIPMIU); and
(iii) Submit to DSMC on a monthly basis documentation of sources of materials.

92. **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) Excavate the foundations at the same time as the access roads (if needed) are built so that dug material is used immediately, avoiding the need to stockpile on site;
(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.

93. **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;

[5] Occupational Health & Safety of employees working only in factories and mines have been specifically covered in GOI laws. However, the Constitution of India has provisions to ensure that the health and well-being of all employees are protected and the State has the duty to ensure protection. For this subproject, the mitigation measures were based on the World Bank Environmental, Health, and Safety (EHS) Guidelines.

(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
(vi) Conduct surface quality inspection according to the Environmental Management Plan (EMP).

94. **Noise Levels.** The rock cutting and trenching activities will certainly generate noise and vibrations. The sensitive receptors are the general population in these areas. Noise will be for a short term (about 2-3 days at each location) 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 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;
(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; and
(vi) Maintain maximum sound levels not exceeding 80 decibels (dbA) when measured at a distance of 10 m or more from the vehicle/s.

95. **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 PHED 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.

96. **Accessibility.** Transport infrastructure will be affected as in the narrower streets there is not enough space for excavated soil to be piled off the road. The road itself may also be excavated in places where there is no available land to locate pipes alongside. Traffic will

therefore be disrupted for short periods. Potential impact is negative but short term and reversible by mitigation measures. The construction contractor will be required to:

(i) Plan pipeline work in consultation with the traffic police;
(ii) Conduct work during light traffic;
(iii) Plan work such that trench excavation, pipe laying, and refilling including compacting, at a stretch is completed in a minimum possible time;
(iv) Provide for immediate consolidation of backfilling material to desired compaction to avoid future settlement risk - this will allow immediate road restoration and therefore will minimize disturbance to the traffic 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 (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.

97. **Socio – Economic – Income.** Excavation will obstruct access to residences/commercial building. Disruption of access to commercial establishments may affect livelihood. Since many of the roads are narrow, construction activities may also obstruct traffic. 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 (RP) 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.

98. **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; and

(ii) Secure construction materials from local market.

99. **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 Training[6] 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;
(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; 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.

100. **Community Health and safety.** Hazards posed to the public, specifically in high-pedestrian areas may include traffic accidents and vehicle collision with pedestrians. Most of the project sites are 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:

[6] 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.

(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.

101. **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; and
(v) Request DSMC to report in writing that the necessary environmental restoration work has been adequately performed before acceptance of work.

102. **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; and
(ix) Request SIPMIU/DSMC to report in writing that the camp has been vacated and restored to pre-project conditions before acceptance of work.

103. **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; and
(iv) Inform SIPMIU/DSMC if a find is suspected, and take any action they require ensuring its removal or protection in situ.

C. Operation and Maintenance

1. Screening out Areas of No Significant Impact

104. Because a water supply system should operate without the need for major repair and maintenance, there are several environmental sectors which should be unaffected once the system begins to function. The WTP is located outside the town in an uninhabited and unused area. Thus there are several fields that are not expected to have significant impacts during the operation and maintenance stage of the subproject (**Table 4**).

Table 4: 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

105. **Management.** Mizoram PHED will be responsible for management and implementation of the water supply and sewerage system. This will be supported by a public education campaign. PHED will employ local contractors to conduct repairs, and contractors should be required to operate the same kinds of health and safety procedures as used in the construction phase to protect workers and the public.

106. The water supply and distribution system have a design life of 30 years, during the design period it shall not require major repairs or refurbishments and should operate with little maintenance beyond routine actions required to keep the pumps and other equipment in working order. The stability and integrity of the system will be monitored periodically to detect any problems and allow remedial action if required. Any repairs will be small-scale involving manual, temporary, and short-term works involving regular checking and recording of performance for signs of deterioration, servicing and replacement of parts.

107. The WTP will not function without maintenance, as silt inevitably collects in areas of low flow over time. The project will therefore provide equipment for cleaning the intake, including pipes and winches to remove silt via the inspection chambers, diesel-fuelled pumps to remove blockages, and tankers to transport the waste hygienically.

108. The new WTP will collect and treat raw water from the intake; the raw water will then be treated at the treatment plant. Although treatment will not be to the standards of more developed countries, the technology is approved by the CPHEEO. The final output quality through treatment plant will be within the limits of national standards for drinking water (IS 10500). The Indian standard for treated water is depicted in Table 5.

Table 5: Drinking Water Quality Standards

	Parameter	Desired Limit	Permissible Limit
1	pH	6.5-8.5	No relaxation
2	Colour (Hazen units, maximum)	5	25
3	Odour	unobjectionable	
4	Taste	Agreeable	
5	Turbidity, NTU, Max	5	10
6	Total hardness as $CaCO_3$, Max	300	600
7	Iron as Fe, Max	.30	1.0
8	Chlorides as Cl, Max	250	1000
9	Residual, free chlorine, Min	0.20	
10	Dissolved solids, Max	500	2000
11	Calcium as Ca, Max	75	200
12	Magnesium as Mg, Max	30	100
13	Copper as Cu, Max	0.05	1.5
14	Manganese as Mn, Max	0.01	0.3
15	Sulphate as SO_4, Max	200	400
16	Nitrates as NO_3	45	100
17	Flouride, Max	1.0	1.5
18	Phenolic compounds as C_6H_5OH, Max	0.001	0.002
19	Mercury as Hg, Max	0.001	No relaxation
20	Cadmium as Cd, Max	0.01	No relaxation
21	Selenium as Se, Max	0.01	No relaxation
22	Arsenic as As, Max	0.05	No relaxation
23	Cyanide as CN, Max	0.05	No relaxation
24	Lead as Pb, Max	0.05	No relaxation
25	Zinc as Zn, Max	5	15
26	Anionic detergents as MBAS, Max	0.2	1.0
27	Chromium as Cr^{6+}, Max	0.05	No relaxation
28	Polynuclear aromatic hydrocarbons as PAH, Max	--	--
29	Mineral oil, Max	0.01	0.03
30	Pesticides, Max	Absent	0.001
31	Radioactive materials		
	a) a emitters Bq/l, Max b) b emitters Pci/l, Max	-- --	0.1 1
32	Alkalinity, Max	200	600
33	Aluminium as Al, Max	0.03	0.2
34	Boron, Max	1	5

D. Cumulative Impact Assessment

109. 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. The subproject's potential cumulative effects will be examined 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.

110. In addition, the CIA considered the scope or influence of the subproject. Two boundaries, spatial and temporal[7], were used.

111. The subproject IEE has identified the VCs to be 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 overlap with the subproject. The spatial and temporal boundary of the subproject is the whole GAPA.

112. Air quality effects will occur during construction. 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.

113. During construction noise levels in the immediate proximity of most work sites are expected to increase. The duration of this exposure will be relatively brief. This exposure represents a temporary, localized, adverse residual effect of low to moderate significance for affected receptors. While building damage due to ground vibrations is unlikely, there may be annoyance to spatially located receptors during construction. Noise levels associated with the project operations will be largely imperceptible as the WTP site is located far from the city proper.

114. 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

[7] 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.

construction–related traffic. There should be improved traffic movement along the alignment once construction is completed. Since the subproject will be built in undeveloped land earmarked for wastewater treatment purposes, it will not conflict with existing or planned land use. However, following improvement in infrastructures and services, added residential developments, commercial and business facilities and increased densities are expected to develop and enhance the subproject area. This can be considered a long-term cumulative benefit of the subproject.

115. Conversion of the private land, although barren and unproductive, to an WTP is a relatively small change in the visible landscape and is not likely to be readily apparent at anything at local scale. It is theoretically possible that other private land owners may wish to sell adjacent unproductive lands in the future for similar purposes but there is no program to promote this nor are there any known plans for such operations. This cumulative impact will therefore not considered as significant. It is also unlikely that the establishment of the WTP will encourage significant development of similar raw water treatment facilities by the concern authority.

116. Adverse impacts such as localized disruption of vehicle traffic and pedestrian movements in areas along the alignment, and elevated CAC and fugitive dust emissions in proximity to work sites, elevated noise and vibration levels and visual impacts will occur during construction. These short-term effects will be mitigated by providing alternate travel routes or alternating traffic movements and, where possible, access to businesses, schools and residences. However, upon completion of construction the socio-community will benefit from improved water supply and wastewater management system. This is considered a long-term cumulative benefit.

117. Development at the WTP site and in the vicinity of the subproject may result in similar impacts relative to water quality and soils, but each impacts are independent of one another and are mitigated on a site-specific basis. Further, while water quality impacts have the ability to compound when taking into account regional water basins into consideration, the subproject will be required to adhere to the mandatory state and local laws, ordinances, regulations, and water quality standards. Regional geologic impacts do not generally compound, and are limited to the site at which they occur.

118. The subproject, when considered with other projects in the same watershed, may result in cumulative impacts to surface and groundwater quality from increased surface impermeability and resultant runoff. Construction projects could result in increased erosion from exposed soil areas, which could contribute sediments into local drainage courses and other waterways. However, it is reasonably assumed that new construction associated with future projects will be required to meet national, state, and local construction and operation standards at least as rigorous as those required at present. Therefore, the potential for cumulative impacts to water quality and soils is deemed to be less than significant.

119. 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 water supply system and sewerage management and community liveability in Aizawl.

120. **General.** The work will follow the same procedures during the construction stage. PHED needs to require its operation and maintenance (O&M) contractor to:

(i) Prepare and submit Operational Manuals for the water supply system and WTP;
(ii) Maintenance of water supply system and WTP should be done as per supplier repairing guideline,
(iii) Ensure compliance of treated water from WTP to the GOI Water Quality standards at all times;
(iv) Maintain a record of quantity and end-users of water; and
(v) Conduct all water supply network maintenance works during non-monsoon period.

121. If trenches are dug to locate and repair leaks or remove and replace lengths of pipe or illegal connections, the work will follow the same procedures during the construction stage. PHED needs to require its O&M contractor to:

(i) Refill and re-compact trenches soil and backfilled sand will be removed to expose the leaking junction or pipe;
(ii) Conduct work during non-monsoon period; and
(iii) Cover or wet excavated material to prevent dusts.

122. **Ecological Resources.** There are no significant ecological resources in or around the project area of the town, so any repairs or maintenance work can be conducted without ecological impacts. As there is no significant flora and fauna in or around project site, there should also not be any ecological impacts from the increase in abstraction.

123. **Economic Development.** Although network repairs could result in shops losing some business if the work means that access is difficult for customers, any losses will be small and short-lived and will probably be at the level of normal business fluctuations. It should therefore not be necessary to compensate for such losses. Nevertheless PHED needs to require its O&M contractor to:

(i) Inform all residents, businesses and sensitive receptors about the nature and duration of any work well in advance so that they can make preparations if necessary;
(ii) Consult city authorities regarding any such work so that it can be planned to avoid traffic disruption as far as possible, and road diversions can be organised if necessary.

124. The provision of an improved and expanded water supply system is not expected to have direct economic benefits for business or industry, as connections will only be provided to domestic users. However businesses will almost certainly benefit from the expected improvement in the health and well-being of their workforce as this should result in fewer days lost through illness, and overall increased productivity.

125. The use of local contractors will provide economic benefits to the companies and the workers they employ. There is however little prospect of directing these benefits to persons affected by any maintenance or repair works as contractors will utilize their existing workforce. To provide at least some economic benefits to affected communities, unskilled persons employed to maintain and operate the WTP should be residents of the neighboring area.

126. **Social and Cultural Resources.** There is no risk of excavation in the city discovering material of historical or archaeological importance, there will be no need to take precautions to protect such material when areas are excavated to repair.

127. Repair works could cause some temporary disruption of activities at locations of social and cultural importance such as schools, hospitals, temples, tourist sites etc, so the same precautions as employed during the construction period should be adopted. PHED needs to require its O&M contractor to:

(i) Consult the city authorities to identify any buildings at risk from vibration damage and avoiding any use of pneumatic drills or heavy vehicles in the vicinity;
(ii) Complete work in these areas quickly;
(iii) Consult municipal authorities, custodians of important buildings, cultural and tourism authorities and local communities in advance of the work to identify and address key issues, and avoid working at sensitive times, such as religious and cultural festivals.

128. The citizens of the Aizawl will be the major beneficiaries of the improved water supply, as they will be provided with a constant supply of better quality water, piped into their homes. In addition to improved environmental conditions, the subproject will improve the over-all health condition of the town as diseases of poor sanitation (such as diarrhoea and dysentery) will be reduced.

VI. PUBLIC CONSULTATION AND INFORMATION DISCLOSURE

A. Project Stakeholders

129. A stakeholder consultation was taken up 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.

130. The social, gender and environmental groups consulted in Aizawl will be Centre for Science and Environment, Science Teachers Association of Mizoram and Clean Mizoram Society. The Community Building Organizations (CBOs) in Aizawl included the Young Men's Christian Association (YMCA), the Mizo Hmeichhia Inzawmkhawm Pawl (MHIP) which is the women's Organization and the old People's Association, MUP.

131. Consultation with project stakeholders is 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. Public Consultations

132. Public consultations were conducted to gather feedback from local people on the proposed development and perceived socio-economic impacts. Meetings and consultations with relevant Government Departments were carried out to assess the Project approach. Public

consultations through Focus Group Discussions (FGDs) with project beneficiaries and project-affected people have been carried out. Consultations were also carried of out during the course environment impact assessment.

133. In the course of preparation of safeguard document, participatory discussion was held with the people around the proposed land project site by means of Focus Group Discussions (FGD). These were held separately with local people, including the youths & the women.

134. A series of public consultation meetings were conducted during the project preparation. Various forms of public consultations (consultation through ad hoc discussions on site and town-level consultation) have been used to discuss the project and involve the community in planning the project and mitigation measures.

Date/Month	Location	No. of Participants	Type of Participants	Topics Discussed	Issues Raised
15 Jul 2012	YMA hall Chhinga Veng	F- 12 M- 18 comprising of male and female	Local council men\mbers, NGOs and local resident members	Project details and its Positive and negative impact of the construction of the Water Supply System Local community response towards the project Potential positive and negative impacts of the project ADB safeguards policy and entitlements Access disruption and inconveniences that may cause during construction work. Step to be taken to mitigate impacts during construction period.	Local people &community participation in project implementation. Better/improved water supply service. E.g (i) timings of supply, quick service on repair and maintenance, good quality, etc.
18 Jul 2012	Electric Veng YMA hall	M-16 F-13 comprising male and female	Local council men\mbers, NGOs and local resident members	Same as above	Local people &community participation in project implementation. Better/improved water supply service. (as bove)
13th Feb 2015	Project Director, SIPMIU Office	M-4	Land donor for GSR at Tuivamit, third party.	Requirement of land and suitability of location for constructing GSR	Landowner's requirement for developing approach road and

Date/Month	Location	No. of Participants	Type of Participants	Topics Discussed	Issues Raised
				Socio economic profile of AP Potential positive and negative impacts of the project ADB safeguards policy and entitlements Agreement	water supply to his residence
14th Feb 2015	Tanhril	M-10 F-7	Landowner of WTP and 3 others for approach road, local people, council members	Requirement of land and suitability of location for WTP. Requirement of approach road Development of Aizawl City and benefits to community	Landowner for proposed land for WTP location indicated willingness to sell land as he feels that value of his remaning land will increase. Long before the proposals for the project were formulated, 4 landowners had reserved land for approach road. Construction of approach road (intake-WTP) will not only develop the area but will provide many income opportunities in future. NOC was obtained from all landowners, who requested SIPMIU to construct good quality black top road. Following measurement survey, agreement with landowners will be signed.
28th March 2015	Phunchawng	M-5 F-1	Landowner for GSR at Phunchawng and community members	Requirment of land for constructing GSR. Socio economic profile of AP Potential positive and negative impacts of the project ADB safeguards policy and	Land owner has no objection to donating land. Expects free water connection in return.

Date/Month	Location	No. of Participants	Type of Participants	Topics Discussed	Issues Raised
				entitlements Agreement	
23 April 2015		M-4	Lessees/donors of approach road land	No coercion involved; happy to give up lease rights for required approach road as it will help them access and develop their lands and increase their income.	Compensation for valuable trees/bamboo, if any was raised by 1 lessee.

B. Future Consultation and Disclosure

135. 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 will continuously (i) conduct a wide range of activities in relation to all subprojects in the city; and (ii) ensure the needs and concerns of stakeholders are registered and are addressed in subproject design.

136. For this subproject, the NGO\ Local council members will develop, in close coordination with SIPMIU and DSMC, a public consultation and disclosure program which is likely 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:
- (a) 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;

- (b) 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
- (c) 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.

137. 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; (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.

VII. GRIEVANCE REDRESS MECHANISM

138. 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.

139. 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.

140. 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.

141. 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 2 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.

142. **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.

143. 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.

144. 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.

145. **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.

146. **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.

147. **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 10.

Figure 10: NERCCDIP Grievance Redress Mechanism

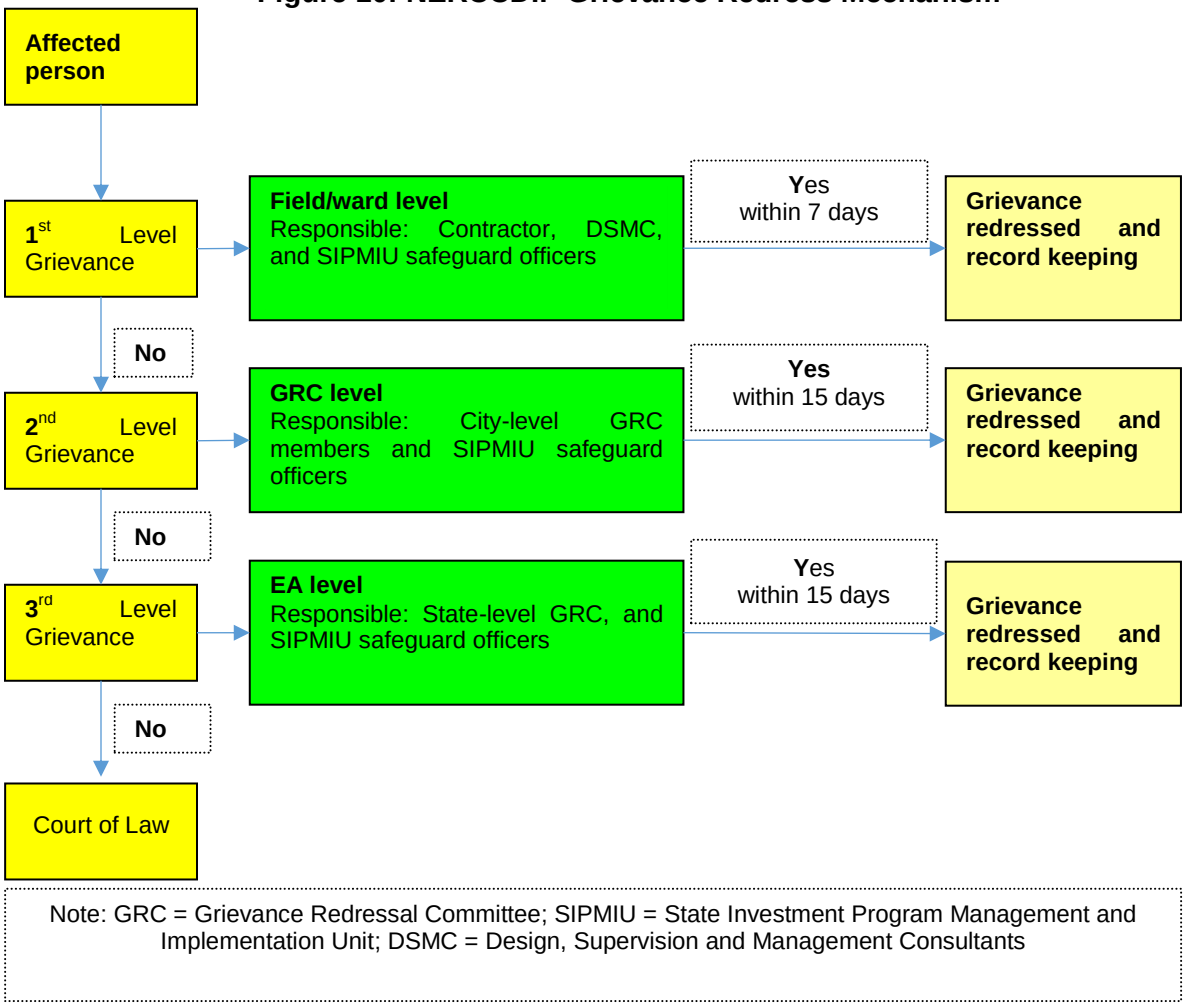

Table No 6: GRC Member for NERCCDIP Aizawl

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

VIII. ENVIRONMENTAL MANAGEMENT PLAN

A. Implementation Arrangements

148. 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).

149. 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.

150. 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.

151. **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

152. 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 7.

Table 7: Proposed Institutional Capacity Building Program

Description	Contents	Schedule	Participants
Pre-construction stage			
Orientation workshop	**Module 1 – Orientation** • ADB Safeguards Policy Statement • GoI Environmental Laws and Regulations **Module 2 – Environmental Assessment Process** • ADB environmental process, identification of impacts	1 day	Officials and SIPMIU involved in the project implementation

Description	Contents	Schedule	Participants
	and mitigation measures, formulation of an environmental management plan (EMP), implementation, and monitoring requirements • Review of environmental assessment report to comply with ADB requirements • Incorporation of EMP into the project design and contracts		
Construction stage			
Orientation program/ workshop for contractors and supervisory staff	• Roles and responsibilities of officials/contractors/ consultants towards protection of environment • Environmental issues during construction • Implementation of EMP • Monitoring of EMP implementation • Reporting requirements	1 day	SIPMIU Contractors
Experiences and best practices sharing	• Experiences on EMP implementation – issues and challenges • Best practices followed	1 day on a regular period to be determined by EAs, SIPMIUs, consultants and contractors	SIPMIUs

C. Environmental Mitigation Plan

153. **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

154. **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 8: 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) Consent to Establish under Water (Prevention and Control of Pollution) Act (ii) Consent to Establish under Air (Prevention and Control of Pollution) Act	SIPMIU with assistance from DSMC	(i) Consent to Establish (Water) (ii) Consent to Establish (Air)
Utilities	Telephone lines, electric poles and wires, water lines within proposed project area	(i) Identify and include locations and operators of these utilities in the detailed design documents to prevent unnecessary disruption of services during construction phase; and (ii) Require construction contractors to prepare a EMP to include actions to be done in case of unintentional interruption of services.	DSMC	(i) List of affected utilities and operators; (ii) Bid document to include requirement for a contingency plan for service interruptions
Social and Cultural Resources	Ground disturbance can uncover and damage archaeological and historical remains	(i) Consult Archaeological Survey of India (ASI) or concerned dept. of the State Govt. to obtain an expert assessment of the archaeological potential of the site; (ii) Consider alternatives if the site is found to be of medium or 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	SIPMIU & DSMC	Chance Finds Protocol

Field	Anticipated Impact	Mitigation Measures	Responsible for Mitigation	Monitoring of Mitigation
		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 SIPMU and (iii) If additional quarries will be required after construction is started,	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
		inform construction contractor to obtain a written approval from SIPMU.		

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 9: 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 Investment SIPMIU; (iii) If additional quarries will be required after construction has started, obtain written approval from SIPMIU; and; (iv) 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 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	(i) Consult with SIPMIU/DSMC on the designated areas for stockpiling of clay, soils, gravel, and other construction materials; (iii) Damp down exposed soil and any stockpiled on site by spraying with water when necessary during dry weather;	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);

Field	Anticipated Impact	Mitigation Measures	Responsible for Mitigation	Monitoring of Mitigation
	hydrocarbons)	(iv) Use tarpaulins to cover sand and other loose material when transported by trucks; and (v) Fit all heavy equipment and machinery with air pollution control devices which are operating correctly.		(v) Vehicular emissions such as sulphur dioxide (SO_2), 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 (vi) Conduct surface quality inspection	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
		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) Require horns not be used unless it is necessary to warn other road users or animals of the vehicle's approach; (iii) 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; and (iv) Maintain maximum sound levels not exceeding 80 decibels (dbA) when measured at a distance of 10 m or more from the vehicle/s.	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
Existing Infrastructure and Facilities	Disruption of service and damage to existing infrastructure at specified project location	(i) Obtain from SIPMIU/DSMC the list of affected utilities and operators if any; (ii) Prepare a contingency plan to include actions to	Construction Contractor	Existing Utilities Contingency Plan

Field	Anticipated Impact	Mitigation Measures	Responsible for Mitigation	Monitoring of Mitigation
		be done in case of unintentional interruption of service		
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; (ii) Coordinate with AMC/PHED for beneficial uses of excess excavated soils or immediately dispose to designated areas; (iv) Recover used oil and lubricants and reuse or remove from the sites; (v) Manage solid waste according to the following preference hierarchy: reuse, recycling and disposal to designated areas; (vi) Remove all wreckage, rubbish; and (vii) Request SIPMIU/DSMC to report in writing that the necessary environmental restoration work has been adequately performed before acceptance of work.	Construction Contractor	(i) Waste Management Plan; (ii) Complaints from sensitive receptors; (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) Plan transportation routes so that heavy vehicles do not use narrow local roads, except in the immediate vicinity of delivery sites; (ii) Schedule transport and	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
		hauling activities during non-peak hours; (iii) Locate entry and exit points in areas where there is low potential for traffic congestion; (iv) Keep the site free from all unnecessary obstructions; (v) Drive vehicles in a considerate manner; (vi) Coordinate with Aizawl Traffic Police Office for temporary road diversions and with for provision of traffic aids if transportation activities cannot be avoided during peak hours; and (vii) Notify affected sensitive receptors by providing sign boards informing nature and duration of construction works and contact numbers for concerns/complaints.		
Socio-Economic – Income.	Impede the access of residents and customers to nearby shops	(i) Leave spaces for access between mounds of soil; (ii) Provide walkways and metal sheets where required for people; (iii) Increase workforce in front of critical areas such as institutions, place of worship, business establishment, hospitals,	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 schools; (iv) Consult businesses and institutions regarding operating hours and factoring this in work schedules; and (v) 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; and (ii) 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 like helmet, gumboot, safety belt, gloves, nose musk and ear plugs; (c) H&S Training for all site personnel; (d) documented procedures to be followed for all site activities; and	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&S orientation trainings (viii) personal protective

Field	Anticipated Impact	Mitigation Measures	Responsible for Mitigation	Monitoring of Mitigation
		(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		equipments; (ix) % of moving equipment outfitted with audible back-up alarms; (xi) sign boards for 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
		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 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	(i) Plan routes to avoid times of peak-pedestrian activities. (ii) Liaise with	Construction Contractor	(i) Traffic Management Plan; (ii) Complaints from

Field	Anticipated Impact	Mitigation Measures	Responsible for Mitigation	Monitoring of Mitigation
		SIPMIU/DSMC in identifying high-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.		sensitive receptors
Child Labour	Tendency of Contractors employing under age labours due to many reasons.	Regular check of site will be carried out by DSMC. Contractor will be asked to require getting certification from Local Council of the jurisdiction for not employing under age labour. Issuance of identification cards (or any type of identification) for officially-hired workers as an additional measure, to check for minors working on site, if any.	DSMC	(i) Certificate from Local Council
Gender Equality		(i)Contractor will ensure equality in terms of employment without any discrimination of gender. (ii)Women workers should be paid equally like men for the same work. Contractor will ensure and implement equal pay for equal work without any	Construction Contractor, DSMC & SIPMIU	Include in tender document of the contractors.

Field	Anticipated Impact	Mitigation Measures	Responsible for Mitigation	Monitoring of Mitigation
		discrimination of gender identity. (iii)Contractor will provide facilities like toilet, crèche etc. especially for women labour at the work site. (iv)Contractor will maintain separate columns for identification of the labourer sex (male/female) in the pay roll register (v)Signboard on with the notion 'same-pay-for same work' to be put up at all work site.		
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;	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
		(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 (such as buildings, shelters, and latrines) which are no longer required; and (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	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 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 10: Anticipated Impacts and Mitigation Measures – Operation and Maintenance Environmental Mitigation Plan

Field	Anticipated Impact	Mitigation Measures	Responsible for Mitigation	Monitoring of Mitigation
General Maintenance Work	Dust generation and surplus	(i) Prepare and submit Operation and Maintenance Manual; (ii) Conduct work during non-monsoon period; and (iii) Cover construction material like cement to prevent dusts.	PHED and O&M Contractors	Maintenance Records
Pipe Replacement	Temporary disruption of activities like traffic etc	(i)) Complete work in sensitive areas quickly; (ii) Prepare a traffic diversion or management plan Consultation the town authorities (iii) Inform all residents and businesses persons or institutions about the nature and duration of any work well in advance so that they can make preparations if necessary; (iv) Conduct these works to provide wooden walkways near any excavated site.	PHED and O&M Contractors	(i) Complaints from sensitive receptors (ii) site inspection
Occupational Health and Safety	Adverse impacts on the appearance of surrounding environment and exposure of workers to hazardous debris	(i) Ensure persons employed will be provided with suitable equipment (such as Safety Shoes, Hand Gloves shovels and wheelbarrows); (ii) Ensure First Aid facility at work site.	PHED and O&M Contractors	OH&S Plan approved by PHED
Waste collection & Management	Adverse impacts on the appearance of surrounding environment and exposure	(i)Ensure all removed material will be deposited in the municipal waste	PHED and O&M Contractors	Waste Management Plan approved by PHED

Field	Anticipated Impact	Mitigation Measures	Responsible for Mitigation	Monitoring of Mitigation
	of workers to hazardous debris	storage bins. (ii) Ensure the all non – hazardous waste will be deposited in safe manner at safe site like approved landfill site.		
Impacts on downstream uses at the intake point	Assessment of flows will be done annually by PHED & Minor Irrigation Department of Govt. of Mizoram especially during the lean season, to ensure that there is no impact on the downstream uses.	Officials from PHED & Minor Irrigation Department of Govt. of Mizoram	PHED Department & Minor Irrigation Department, Govt of Mizoram	Annual average discharge , Up – Stream & Down – Stream Flow in lean season
Effectiveness of intake screens	PHED will periodically monitor the effectiveness of the intake screens, in terms of fish sizes and quantities of fish passing through the screen. Any modifications to the screen as required will be taken up in consultation with the concern department	Officials from PHED Department of Govt. of Mizoram	PHED Department , Govt of Mizoram	O&M Manual for WTP
Management of sludge and waste from the Treatment plant	Adverse impacts on the appearance of surrounding environment and exposure of community to hazardous waste	A waste collection system will be in operation to handle solid wastes, oily rags, and used fuel and lube oil filters in a leak-proof container that will be stored and disposed off at the landfill site, to ensure effective management of solid wastes at the treatment plant site. The schedule of desludging will be determined during detailed design phase,	PHED and O&M Contractors	O&M Manual for WTP and Sludge management Plan

Field	Anticipated Impact	Mitigation Measures	Responsible for Mitigation	Monitoring of Mitigation
		however similar projects and designs indicate WTP desludging frequency of every 5 to 7 years. The sludge will be collected and disposed in Aizwal SLF (also part of Tranche 3). Sludge management will be included in the O&M manual to be developed as part of the subproject.		
Effective maintenance of the sludge-drying beds at the WTP	Adverse impacts on the appearance of surrounding environment	(i) Reuse of sludge will be explored after testing to meet government safety standards (ii)Disposal of refuse sludge will be at the sanitary landfill site in Aizawl.	PHED and O&M Contractors	O&M Manual for WTP and Sludge management Plan
Odor from Raw Sludge of WTP	Adverse impacts on the appearance of surrounding environment and local community	Shielding of the unloading bay & green belt around the STP site to an extend to prevent odorous gases being blown away by the wind	PHED and O&M Contractors	O&M Manual for WTP and Raw Sludge management Plan
Maintenance of alternative sources of Power Supply (DG Sets)	Soil and water pollution due to fuel, & lubricants	The fuel storage and DG Set establishment site will be stationed such that runoff from the site does not drain into the clear water storage area. Oil interceptors will be provided	PHED and O&M Contractors	Spot checks by concern PHED authorities to time to time
Economic , Social and Cultural Resources	(i)Impediments to residents and businesses (ii)Temporary disruption of daily activities	(i) Inform all residents and businesses about the nature and duration of any work well in advance so that they can make	PHED and O&M Contractors	Complaints from sensitive receptors

Field	Anticipated Impact	Mitigation Measures	Responsible for Mitigation	Monitoring of Mitigation
		preparations if necessary; (ii) Conduct these works to provide wooden walkways near any excavated site. (iii) Consult the town authorities to identify any buildings at risk from vibration damage and avoiding any use of pneumatic drills or heavy vehicles in the vicinity; (iv) Complete work in sensitive areas quickly; (v) Consult municipal authorities, custodians of important buildings, cultural and tourism authorities and local communities in advance of the work to identify and address key issues, and avoid working at sensitive times, such as religious and cultural festivals		

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

Table 11: Pre-construction Environmental Monitoring Program

Field	Location	Responsible for Mitigation	Monitoring of Mitigation	Method of Monitoring	Indicators/ Standards	Frequency	Responsible for Monitoring
Environmental Clearances	Not applicable	DSMC	follow up with SPCB on clearances	Checking of records	Clearances issued	As required	SIPMIU
Baseline Environmental Condition – Ambient Air Quality	Subproject location	DSMC	Establish baseline values of (i) respirable particulate matter (RPM) and (ii) suspended particulate matter (SPM)	Air sample collection and analyses by in-house laboratory or accredited 3rd party laboratory	GOI Ambient Air Quality Standards	Once prior to start of construction	SIPMIU
Baseline Environmental Condition - Water Quality	Subproject location	DSMC	Establish baseline values of suspended solids (TSS), pH biological oxygen demand (BOD), faecal coliform	Air sample collection and analyses by in-house laboratory or accredited 3rd party laboratory	GOI Water Quality Standards	Once prior to start of construction	SIPMIU
Utilities	As per site requirement	DSMC	(i) List of affected utilities if any and operators; (ii) Bid document to include requirement for a contingency plan for service interruptions	Checking of records	(i) List of affected utilities and operators prepared; (ii) Requirement for a contingency plan for service interruptions included in bid documents	Once	SIPMIU
Social and Cultural Heritage	As per site requirement	SIPMIU and DSMC	Chance Finds Protocol	Checking of records	Chance Finds Protocol provided to construction	Once	SIPMIU

Field	Location	Responsible for Mitigation	Monitoring of Mitigation	Method of Monitoring	Indicators/ Standards	Frequency	Responsible for Monitoring
					contractors prior to commencement of activities		
Construction work camps, hot mix plants, stockpile areas, storage areas, and disposal areas.	As per site requirement	SIPMIU and DSMC to determine locations prior to award of construction contracts.	List of selected location for construction work camps, hot mix plants, stockpile areas, storage areas, and disposal areas.	Checking of records	List of selected sites for construction work camps, hot mix plants, stockpile areas, storage areas, and disposal areas provided to construction contractors prior to commencement of works.	Once	SIPMIU
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

Field	Location	Responsible for Mitigation	Monitoring of Mitigation	Method of Monitoring	Indicators/ Standards	Frequency	Responsible for Monitoring
Contractors EMP	As per site requirement	Contractors Environment Representative will prepare EMP for approval to DSMC before work commencement	EMP will include all the monitoring fields required as mentioned in the tender documents	Checking of reports, mitigation measures requirement etc	In consultation with DSMC environment specialist.	Once	Contractor

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

Table 12: 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 materials	Construction Contractor	Construction Contractor documentation	(i) Checking of records; (ii) visual inspection of sites	(i) Sites are permitted; (ii) Report submitted by construction contractor monthly (until such time there is excavation work)	Monthly submission for construction contractor As needed for DSMC	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 (SO_2), nitrous oxides (NOx), carbon monoxide (CO), and hydrocarbons (HC)	(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) GOI Ambient Quality Standards for ambient air quality; (v) GOI Vehicular Emission Standards for SO_2, NOx, CO and HC.	Monthly for checking records	DSMC in coordination with Pollution Control Board
Surface Water	(i) Construction	Construction	(i) Areas for	visual	(i) Designated	Monthly	DSMC in

Field	Location	Responsible for Mitigation	Monitoring of Mitigation	Method of Monitoring	Indicators/ Standards	Frequency	Responsible for Monitoring
Quality	sites; (ii) areas for stockpiles, storage of fuels and lubricants and waste materials;	Contractor	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.	inspection	areas only; (ii) silt traps installed and functioning; (iii) no noticeable increase in suspended solids and silt from construction activities (iv) GOI Standards for Water Discharges to Inland Waters and Land for Irrigation		coordination with Pollution Control Board
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	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
					where necessary		
Existing Utilities and Infrastructure	Construction sites	Construction Contractor	(i) Existing Utilities Contingency Plan	(i) Checking of records; (ii) visual inspection	Implementation according to Utilities Contingency Plan	As needed	DSMC
Landscape and Aesthetics	(i) Construction sites; (ii) areas for stockpiles, storage of fuels and lubricants and waste materials; (iii) work camps	Construction Contractor	(i) Waste Management Plan; (ii) complaints from sensitive receptors; (iii) 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	(i)No accumulation of solid wastes on-site; (ii) implementation of Waste Management Plan; (iii) complaints from sensitive receptors satisfactorily addressed.	Monthly	DSMC
Accessibility	(i) Construction sites; (ii) traffic haul road	Construction Contractor	(i) Traffic Management Plan; (ii) complaints from sensitive receptors; (iii) 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-	Construction	Construction	(i) Complaints	Visual	(i) Complaints	Quarterly	DSMC

Field	Location	Responsible for Mitigation	Monitoring of Mitigation	Method of Monitoring	Indicators/ Standards	Frequency	Responsible for Monitoring
Economic - Income	sites	Contractor	from sensitive receptors; (ii) number of walkways, signages, and metal sheets placed at subproject location.	inspection	from sensitive receptors satisfactorily addressed; (ii) walkways, ramps, and metal sheets provided (iii) signages visible and located in designated areas		
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; (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	(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	Quarterly	DSMC

Field	Location	Responsible for Mitigation	Monitoring of Mitigation	Method of Monitoring	Indicators/ Standards	Frequency	Responsible for Monitoring
			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.		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 addressed	Quarterly	DSMC

Field	Location	Responsible for Mitigation	Monitoring of Mitigation	Method of Monitoring	Indicators/ Standards	Frequency	Responsible for Monitoring
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 13: Operation and Maintenance Environmental Monitoring Program

Field	Location	Responsible for Mitigation	Monitoring of Mitigation	Method of Monitoring	Indicators/ Standards	Frequency	Responsible for Monitoring
Drinking Water Quality	(i) 9 service reservoirs (ii Random sample form domestic users	PHED and O&M Contractors	Comparison with BIS & IMC standard	Sample collection and laboratory analyses	Indicators \ Standard set by BIS or IMC	Quarterly or as prescribed by BIS or IMC	PHED Mizoram
Surface water Quality	Intake Surface water Body	PHED and O&M Contractors	Comparison with Surface Water Quality Standard of CPCB, MOEF	Sample collection and laboratory analyses	Indicators \ Standard set by CPCB	Quarterly or as prescribed by SPCB Mizoram	PHED Mizoram
RPM	Maintenance site	PHED and O&M Contractors	Comparison with RPM limits in NAAQM	Sample collection and laboratory analyses	Standard set by CPCB	Quarterly or as prescribed by CPCB	PHED Mizoram
Noise Level	Maintenance site	PHED and O&M Contractors	Comparison with Noise level limits in NANQM	Sample collection and laboratory analyses	Standard set by CPCB	Quarterly or as prescribed by CPCB	PHED Mizoram
Occupational Health and safety	subproject location	PHED and O&M Contractors	Complaints from sensitive receptors	(i) Records of training; (ii) H&S Plan approved by PHED	Complaints from sensitive receptors satisfactorily addressed	As needed	PHED Mizoram
General Maintenance	subproject location	PHED and O&M Contractors	Complaints from sensitive receptors	Checking of records	Complaints from sensitive receptors satisfactorily addressed	As needed	PHED Mizoram
Community Health and safety	subproject location	PHED and O&M Contractors	Complaints from sensitive receptors	Checking of records	complaints from sensitive receptors satisfactorily addressed	As needed	PHED Mizoram

CPCB = Central Pollution Control Board, O&M = operation and maintenance, PHED = Public Health and Engineering Department, UD&PAD = Urban Development & Poverty Alleviation Department. NAAQM = National Ambient Air Quality Monitoring NANQM = National Ambient Noise Quality Monitoring, BIS= Bureau of Indian standard, IMC = Indian Medical Council, RPM= Respirable Particulate Matter

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E. Environmental Management of Part B Component:

155. **Project Approach Road.** An approach road is required to facilitate completion of the project as per anticipated time schedule. Major components like Minor Bridge, slab culvert and Clear Water Pipe Line & other require structure for the project near village Tanhril; will require have to be interconnected by construction of new road along the bank of setlak river up to its confluence with Tlawng. A minor bridge has to be constructed across river Setlak. The total length of new road to be constructed has been estimated as 4.0 km.The details are given in Table- 14

Table 14 -Details of Roads to be constructed as a part of the Project

Connecting details	Length (km)
Length of road to reach other project components	4.0
A minor bridge on Setlak river	6 sapn
A Slab Culvert on Hilly Drainage	2 Span
Total	4.0 km

156. **Impact due to Construction of Approach Road.** The construction of road can lead to the following impacts: The topography of the project area has steep slope, which descends rapidly into narrow valleys. The conditions can give rise to erosion hazards due to net downhill movement of soil aggregates.

157. Removal of trees on slopes and re-working of the slopes in the immediate vicinity of roads can encourage landslides, erosion gullies, etc. With the removal of vegetal cover, erosive action of water gets pronounced and accelerates the process of soil erosion and formation of deep gullies. Consequently, the hill faces are bared of soil vegetative cover and enormous quantities of soil and rock can move down the rivers, and in some cases, the road itself may get washed out.

158. Construction of new roads increases the accessibility of a hither to undisturbed areas resulting in greater human interferences and subsequent adverse impacts on the ecosystem.

159. The approach road will has to be constructed as a part of the access to the WTP & Water Intake site. In a hilly environment, construction of road sometime disturbs the scenic beauty of the area. In addition, landslides are often triggered due to road construction because of the loosening of rocks by water trickling from various streams.

160. Steeply sloping banks are liable to landslides, which can largely be controlled by provision of suitable drainage. The basic principle is to intercept and divert as much water as possible, before it arrives at a point, where it becomes a nuisance. The other erosion hazard is that of surface erosion of the bank, which is best controlled by vegetation. However, in a steeply sloping terrain, difficulty lies in growing vegetation on steeply sloping banks. Engineering solutions such as surface drainage, sub-surface drainage, toe protection and rock bolting can be used.

161. Landslides can be stabilized by several methods-engineering or bioengineering measures alone or a combination of these. The cost required for implementation of various measures has already been incorporated in the overall budget earmarked for construction of road.

162. In hilly terrain, road construction often generates significant quantity of wastes (Muck) due to the stripping of the rocks to make way for the roads. The stripped muck is generally cleared by dumping the material along the slopes. These dumped materials finally flow down to the valleys and ultimately finds its way to the river. However, it is recommended to adopt a more systematic approach.

163. The stripped material should be collected and dumped in the designated muck disposal area, which will have check dams to prevent the muck to flow down into the river. After disposal operation is complete at the dump site, the dump yard should be contoured and vegetated. The various aspects to be considered while making the project road are briefly described in the following paragraphs.

164. **Construction Stage.** Area for clearing and grubbing shall be kept minimum subject to the technical requirements of the road. The clearing area shall be properly demarcated to save desirable trees and shrubs and to keep tree cutting to the minimum.

165. Where erosion is likely to be a problem, clearing and grubbing operations shall be so scheduled and performed that grading operations and permanent erosion control of features can follow immediately thereafter, if the project conditions permit; otherwise temporary erosion control measures shall be provided between successive construction stages. Under no circumstances, however, should very large surface area of erodible earth material be exposed at any one time by clearing and grubbing.

166. The method of balanced cut and fill formation shall be adopted to avoid large difference in cut and fill quantities.

167. The cut slopes shall be suitably protected by breast walls, provision of flat stable slopes, construction of catch water and intercepting drains, treatment of slopes and unstable areas above and underneath the road, etc.

168. Where rock blasting is involved, controlled blasting techniques shall be adopted to avoid over-shattering of hill faces.

169. Excavated material should not be thrown haphazardly but dumped duly dressed up in a suitable form at appropriate places where it cannot get easily washed away by rain, and such spoil deposits may be duly trapped or provided with some vegetative cover.

170. Drainage of the water from hill slopes and road surface is very important. All artificial drains shall be linked with the existing natural drainage system.

171. Surface drains shall have gentle slopes. Where falls in levels are to be negotiated, check dams with silting basins shall be constructed and that soil is not eroded and carried away by high velocity flows.

172. Location and alignment of culvert should also be so chosen as to avoid severe erosion at outlets and siltation at inlets.

173. Tree felling for road construction/works should be kept bare minimum and strict control must be exercised in consultation with the Forest Department. Equivalent amount of new trees should be planted as integral part of the project within the available land and if necessary, separate additional land may be acquired for this purpose.

174. Depending on the availability of land and other resources, afforestation of roadside land should be carried out to a sufficient distance on either side of the road.

175. Specific Environmental Management Plan for Approach Road. **Table 15 to 17** shows the potential adverse environmental impacts, proposed mitigation measures, responsible parties, and estimated cost of implementation for Proposed Approach Road. This specific EMP will be included in the bid documents and will be further reviewed and updated during implementation. **Table 18 to 20** shows the proposed specific environmental mitigation plan for Approach Road of 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 15: Specific Environmental Mitigation Plan for Approach Road (Design & Pre – Construction Stage)

Sr. No	Anticipated Impact	Mitigation Measures	Responsible for Mitigation	Monitoring of Mitigation
1	Land acquisition and resettlement impacts required due to the project component and sensitive land uses	Land acquisition and resettlement impacts will be mostly temporary impacts will occur for Approach Road. These impacts will be addressed through the RP. The design engineers will also take all measures to avoid sensitive local land uses..	SIPMU / Social Expert DMSC	SIPMU
2	Relocation of utility lines along the approach road	All utilities and services impacted due to the proposed component will be shifted/relocated, with prior approval of the concerned agencies.	SIPMU / DMSC	SIPMU
3	Seismic considerations in design of structures	The designs of the project component, including Cross drainage structure, minor bridge and other civil engineering protection structure follow the IRC Guidelines for Group V Seismic area and hill road procedure	SIPMU / Structural Engineer DMSC	SIPMU
4	Damage to trees and clearance of vegetation at the project locations	(i) Only trees that will require removal within the proposed construction area of the sites will be cut. (ii)After the finalization of the designs and layout of the project component, the trees within proposed construction areas will be marked. (iii) For trees not proposed to be cut, taking all precautions to protect them from any damage from construction activities, including placement of tree	SIPMU / Environmental Expert DMSC	SIPMU

Sr. No	Anticipated Impact	Mitigation Measures	Responsible for Mitigation	Monitoring of Mitigation
		guards will be taken up. (iv)Trees within the corridor of impact (area required for construction) will be felled after prior approval of Forest department.		
5	Pollution control and IEC activities including sanitation facilities and waste collection.	In consultation with the SIPMU, design of sanitation facilities and solid waste collection facilities shall be carried out within lands belonging to the proposed row of approach road.	SIPMU / Environmental Expert DMSC	SIPMU
6	Locations for disposal of spoil	**(i)** A utilization plan for the disposal of earth resulting from the excavation will be prepared by the contractor as part of the spoil management plan. (ii) It is envisaged that nearly 90% of the excavated earth will be utilized for the construction of the access road embankments. (iii)The sites for disposal of the remaining quantities will be identified prior to finalization of the designs, and the same incorporated into the BOQs.	SIPMU / Environmental Expert DMSC	SIPMU
7	Location, selection, design and layout -Construction camps and/or hot mix plants, storage areas, stockpiles, and disposal areas	(i)The construction camps, hot mix plants, storage areas, stockpiles, and disposal areas will be located as per the following sitting criteria (ii) at least 500 m away from habitations and areas notified as ecologically critical areas (ECA), and (iii) At least 100 m away	Contractor / Environmental Expert DMSC	SIPMU

Sr. No	Anticipated Impact	Mitigation Measures	Responsible for Mitigation	Monitoring of Mitigation
		from water bodies. (iv) At these locations, the contractor will work out layouts adhering to the air and water standards prescribed by ISO. (v) Sites to be considered will not promote instability and result in destruction of property, vegetation, irri gation, and/or drinking water supply systems. (vi) All locations will be included in the design specifications and plan drawings		
8	Identification of sources of materials	The contractor, at the detailed design stage, shall (i) identify all potential material sources; (ii) propose quarry sites and sources permitted by government; and (iii) Verify suitability of all material sources and obtain approval of DMSC.	Contractor / Environmental Expert DMSC	SIPMU

Table 16: Specific Environmental Mitigation Plan for Approach Road (Construction Stage)

Sr. No	Anticipated Impact	Mitigation Measures	Responsible for Mitigation	Monitoring of Mitigation
1	Quarry/borrow pit operations	The contractor will: (i) obtain approval of implementing agency if new quarries and borrow sites if necessary; (ii) store stripped materials as not to disrupt natural drainage and protect them to prevent erosion and migration of soil particles into surface waters; (iii) provide temporary ditches	Contractor / Environmental Expert DMSC	SIPMU

		and/or settling basins to collect run-off water and to prevent erosion and contamination of surface water; (iv) plant exposed areas with suitable vegetation at the earliest opportunity and prevent ponding of water through temporary drains discharging to natural drainage channels; (v) Restore sites after construction activities by stabilizing contours and slopes, spreading stripped materials to promote percolation and re-growth of vegetation, and draining any standing water. Land utilized for quarry sites access roads will also be restored; and (vi) Ensure adequate safety precautions during transportation of quarry material from quarries to the construction site. Vehicles transporting the material will be covered to prevent spillage		
2	Damages to utilities and services during construction	The contractor will be required to: (i) plan for immediate attendance by the service providers to any damages to utilities during construction; (ii) replace (or compensate for) public and private physical structures damaged due to construction or vibration;	Contractor / Environmental Expert DMSC	SIPMU

		(iii) Provide prior public information about the likely disruption of services. (iv)In consultation and with support from SIPMU, the contractor will provide alternate arrangements for water supply in the event of disruption beyond reasonable time, for instance, through tankers.		
3	Stockpiling of construction materials, excavated earth/spoil from trenches	Due consideration will be given for material storage and construction sites such that it doesn't cause any hindrance to daily traffic movement. The contractor will (i) consult with implementing agency on the designated areas for stockpiling of clay, soils, gravel, and other construction materials; (ii) avoid stockpiling of earth fill, especially during the rainy season, unless covered by tarpaulins or plastic sheets; (iii) prioritize reuse of excess spoils and materials in the construction works; and (iv) protect surface water bodies from any source of contamination, such as oily wastes, debris, and spoils that will degrade its quality	Contractor / Environmental Expert DMSC	SIPMU
4	Soil erosion	(i)The measures to address soil erosion at the proposed facilities will consist of measures as per design, or as directed by the DMSC to	Contractor / Environmental Expert DMSC	SIPMU

		control soil erosion, sedimentation, and water pollution. (ii)All temporary sedimentation, pollution control works, and maintenance thereof will be deemed incidental to the earthwork or other items of work.		
5	Use of explosive materials	(i)Except as may be provided in the contract or ordered or authorized by the DMSC, the contractor will not use explosives. (ii)The contractor will, at all times, take every possible precaution, and will comply with appropriate laws and regulations relating to the importation, handling, transportation, storage, and use of explosives and will, at all times when engaged in blasting operations, post sufficient warning flagmen. (iii)The use of explosive materials will be carried out by the contractor only after obtaining written approval of the DMSC of the procedures to be followed	Contractor / Environmental Expert DMSC	SIPMU
6	Soil and water pollution due to fuel, lubricants, and construction	(i)The fuel storage and vehicle cleaning area will be stationed such that runoff from the site does not drain into the water bodies/ponds abutting the construction sites. (ii)Oil interceptors will be provided at construction vehicle parking areas,	Contractor / Environmental Expert DMSC	SIPMU

		vehicle repair areas, and workshops, ensuring that all wastewater flows into the interceptor prior to its discharge. (iii) All work sites will be cleaned and restored to pre-project conditions. (iv) Discharge standards promulgated under Schedule, standards for waste from industrial units or projects waste will be strictly adhered to.		
7	Generation of dust	The contractor will (i) take every precaution to reduce the levels of dust at construction sites, and not exceeding the pre-project ambient air quality standards; (ii) fit all heavy equipment and machinery with air pollution control devices that are operating correctly; (iii) reduce dust by spraying stockpiled soil, excavated materials, and spoils; (iv) cover with tarpaulin vehicles transporting soil and sand; and (v) cover stockpiled construction materials with tarpaulin or plastic sheets	Contractor / Environmental Expert DMSC	SIPMU
8	Emission from construction vehicles, equipment, and machinery	All vehicles, equipment, and machinery used for construction will be regularly maintained to ensure that pollution emission levels comply with the relevant requirements of CPCB. Copies of conformance will	Contractor / Environmental Expert DMSC	SIPMU

		be submitted regularly to the DMSC.		
9	Movement of construction vehicles	(i)The movement of construction materials and equipment, to the extent possible, will be planned along access roads to the site. (ii) In the event of movement of construction vehicles and equipment on the narrow roads, strengthening of these roads will be carried out, and timing of movement of heavy vehicles worked out to avoid peak hours and nighttime, and to ensure minimal disturbances to the communities and the resident population along these roads	Contractor / Environmental Expert DMSC	SIPMU
10	Noise from construction equipment	The contractor will ensure (i) regular maintenance of vehicles, equipment, and machinery to keep noise from these at a minimum; and (ii) all vehicles and equipment used for construction will be fitted with exhaust silencers. During routine servicing operations, the effectiveness of exhaust silencers will be checked, and if found to be defective, will be replaced.	Contractor / Environmental Expert DMSC	SIPMU
11	Material handling at site	(i) All workers employed for mixing asphaltic material, cement, concrete, etc. will be provided with protective footwear and goggles.	Contractor / Environmental Expert DMSC	SIPMU

		Workers engaged in welding (ii) works will be provided with welder's protective eye shields. The use of any toxic chemical will be strictly in accordance with the manufacturer's instructions.		
12	Disposal of bituminous wastes /construction waste/debris/cut material	(i) For project component the contractor will prepare and implement a waste management plan. (ii) Safe disposal of the extraneous material will be ensured in the pre-identified disposal locations. To enable minimization of waste disposal and do this in an environmentally safe manner, the waste management plan (iii) Recover used oil and lubricants and reuse or remove from the site; (iii) Manage solid waste according to the following preference hierarchy: reuse, recycle, and dispose of in designated areas; (iv) Reuse bituminous waste generated in road construction, based on its suitability for reuse, to the maximum extent possible. (v) Cut material generated because of construction will be utilized as filling material. Remaining material if any will be disposed off safely at the disposal sites; (vi) Remove all wreckage, rubbish, or temporary structures that are no longer	Contractor / Environmental Expert DMSC	SIPMU

		required; and (vii) Restore pre-project environmental conditions through implementation of environmental restoration work		
13	Safety measures during construction	The contractor will comply with all regulations regarding safe scaffolding, ladders, working platforms, gangway, stairwells, excavations, trenches, and safe means of entry and egress.	Contractor / Environmental Expert DMSC	SIPMU
14	Risk caused by force majeure	All reasonable precaution will be taken to prevent danger to the workers and the public from fire, flood, drowning, etc. Specifically, the contractor will (i) provide medical and accident insurance for workers; (ii) provide first aid in the construction camp site; and (iii) provide access to hospitals/clinics within the project site that can be accessed in case of emergency by arranging necessary transport for safe carriage of the injured	Contractor / Environmental Expert DMSC	SIPMU
15	Malaria risk	The contractor will, at his own expense, conform to all anti-malaria instructions given to him by the DMSC.	Contractor / Environmental Expert DMSC	SIPMU
16	First aid	(i) At every workplace, a readily available first aid unit, including an adequate supply of sterilized dressing material and appliances, will be provided as per the factory rules. (ii)Suitable transport will be	Contractor / Environmental Expert DMSC	SIPMU

		provided to facilitate transfer of injured or ill persons to the nearest hospital. At every workplace and construction camp, equipment and nursing staff will be provided		
17	Hygiene in the construction camps and sites	(i) All temporary accommodations will be constructed and maintained in such a fashion that uncontaminated water is available for drinking, cooking, and washing. Safe drinking water in sufficient quantity for the work force will be provided at the construction site as emptied, and the garbage disposed of in a hygienic manner. (ii) Adequate health care will be provided for the work force. Unless otherwise arranged for by the local sanitary authority, the local medical health or municipal authorities will make arrangement for disposal of excreta. (iii) On completion of the works, all such temporary structures will be cleared away, all rubbish burned, excreta tank and other disposal pits or trenches filled in and effectively sealed off, and the outline site left clean and tidy, at the contractor's expense. (iv) The site will be restored to pre-project conditions through removal of all	Contractor / Environmental Expert DMSC	SIPMU

		extraneous material on site		
18	Clearing of construction of camps and restoration	(i) Contractor will prepare site restoration plans for approval by the DMSC. The plan will be implemented by the contractor prior to demobilization. (ii) On completion of the works, all temporary structures will be cleared away, all rubbish burned, excreta or other disposal pits or trenches filled in and effectively sealed off, and the site left clean and tidy, at the contractor's expense. (iii) The site will be restored to pre-project conditions through removal of all extraneous material on site	Contractor / Environmental Expert DMSC	SIPMU

Table 17: Specific Environmental Mitigation Plan for Approach Road (Operation & Maintenance Stage)

Field	Anticipated Impact	Mitigation Measures	Responsible for Mitigation	Monitoring of Mitigation
General Maintenance Work	Dust generation and surplus	(i) Prepare and submit Operation and Maintenance Manual; (ii) Conduct work during non-monsoon period; and (iii) Cover construction material like cement to prevent dusts.	PHED and O&M Contractors	Maintenance Records
Pavement Removal & Laying	Temporary disruption of activities like traffic etc	(i)) Complete work in sensitive areas quickly; (ii) Prepare a traffic diversion or management plan Consultation the town authorities (iii) Inform all residents and businesses persons or institutions about the nature and duration of any work well in advance so that they	PHED and O&M Contractors	(i) Complaints from sensitive receptors (ii) site inspection

Field	Anticipated Impact	Mitigation Measures	Responsible for Mitigation	Monitoring of Mitigation
		can make preparations if necessary; (iv) Conduct these works to provide wooden walkways near any excavated site.		
Occupational Health and Safety	Adverse impacts on the appearance of surrounding environment and exposure of workers to hazardous debris	(i) Ensure persons employed will be provided with suitable equipment (such as Safety Shoes, Hand Gloves shovels and wheelbarrows); (ii) Ensure First Aid facility at work site.	PHED and O&M Contractors	OH&S Plan approved by PHED
Waste collection & Management	Adverse impacts on the appearance of surrounding environment and exposure of workers to hazardous debris	(i)Ensure all Non – hazardous removed material will be deposited in the municipal waste storage bins. (ii) Ensure the all hazardous waste will be deposited in safe manner at safe site like approved landfill site.	PHED and O&M Contractors	Waste Management Plan approved by PHED
Impacts on stream uses at the cross drainage structure in late & out late point	Adverse impacts on the appearance of stream, chocking of in let or out let causes flooding	Ensure the all the cross drainage structure must be clear before and after Monsoon season	PHED and O&M Contractors	By O&M manual for cross drainage structure
Management of sludge and waste from the Drain along the approach road.	Adverse impacts on the appearance of drain along the approach road, chocking of drain causes flooding	Ensure the all the drainage structure must be clear before and after Monsoon season	PHED and O&M Contractors	By O&M manual for drainage structure
Economic , Social and Cultural Resources	(i)Impediments to residents and businesses (ii)Temporary disruption of daily activities	(i) Inform all residents and businesses about the nature and duration of any work well in advance so that they can make preparations if necessary; (ii) Conduct these works to provide wooden walkways near any excavated site. (iii) Consult the town	PHED and O&M Contractors	Complaints from sensitive receptors

Field	Anticipated Impact	Mitigation Measures	Responsible for Mitigation	Monitoring of Mitigation
		authorities to identify any buildings at risk from vibration damage and avoiding any use of pneumatic drills or heavy vehicles in the vicinity; (iv) Complete work in sensitive areas quickly; (v) Consult municipal authorities, custodians of important buildings, cultural and tourism authorities and local communities in advance of the work to identify and address key issues, and avoid working at sensitive times, such as religious and cultural festivals		

Table 18: Pre-construction Environmental Monitoring Program (Approach Road)

Field	Location	Responsible for Mitigation	Monitoring of Mitigation	Method of Monitoring	Indicators/ Standards	Frequency	Responsible for Monitoring
Environmental Clearances	Not applicable	DSMC	follow up with SPCB on clearances	Checking of records	Clearances issued	As required	SIPMIU
Baseline Environmental Condition – Ambient Air Quality	Subproject location	DSMC	Establish baseline values of (i) respirable particulate matter (RPM) and (ii) suspended particulate matter (SPM)	Air sample collection and analyses by in-house laboratory or accredited 3rd party laboratory	GOI Ambient Air Quality Standards	Once prior to start of construction	SIPMIU
Baseline Environmental Condition - Water Quality	Subproject location	DSMC	Establish baseline values of suspended solids (TSS), pH biological oxygen demand	Air sample collection and analyses by in-house laboratory or accredited 3rd party laboratory	GOI Water Quality Standards	Once prior to start of construction	SIPMIU

Field	Location	Responsible for Mitigation	Monitoring of Mitigation	Method of Monitoring	Indicators/ Standards	Frequency	Responsible for Monitoring
			(BOD), faecal coliform				
Utilities	As per site requirement	DSMC	(i) List of affected utilities if any and operators; (ii) Bid document to include requirement for a contingency plan for service interruptions	Checking of records	(i) List of affected utilities and operators prepared; (ii) Requirement for a contingency plan for service interruptions included in bid documents	Once	SIPMIU
Social and Cultural Heritage	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, storage areas, and disposal areas.	As per site requirement	SIPMIU and DSMC to determine locations prior to award of construction contracts.	List of selected location for construction work camps, hot mix plants, stockpile areas, storage areas, and disposal areas.	Checking of records	List of selected sites for construction work camps, hot mix plants, stockpile areas, storage areas, and disposal areas provided to construction contractors prior to commencement of works.	Once	SIPMIU
Sources of Materials	As per site requirement	SIPMIU and DSMC to prepare list of approved quarry	(i)List of approved quarry sites and sources of	Checking of records	(i) List of approved quarry sites and sources of	Once	SIPMIU

Field	Location	Responsible for Mitigation	Monitoring of Mitigation	Method of Monitoring	Indicators/ Standards	Frequency	Responsible for Monitoring
		sites and sources of materials	materials; (ii) Bid document to include requirement for verification of suitability of sources and permit for additional quarry sites if necessary.		materials provided to construction contractors (ii) Bid document included requirement for verification of suitability of sources and permit for additional quarry sites if necessary.		
Contractors EMP	As per site requirement	Contractors Environment Representative will prepare EMP for approval to DSMC before work commencement	EMP will include all the monitoring fields required as mentioned in the tender documents	Checking of reports, mitigation measures requirement etc	In consultation with DSMC environment specialist.	Once	Contractor

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

Table 19: Construction Environmental Monitoring Program (Approach Road)

Field	Location	Responsible for Mitigation	Monitoring of Mitigation	Method of Monitoring	Indicators/ Standards	Frequency	Responsible for Monitoring
Sources of Materials	Quarries and sources of materials	Construction Contractor	Construction Contractor documentation	(i) Checking of records; (ii) visual inspection of sites	(i) Sites are permitted; (ii) Report submitted by construction contractor monthly (until such time there is excavation work)	Monthly submission for construction contractor As needed for DSMC	DSMC
Air Quality	Construction	Construction	(i) Location of	(i) Checking of	(i) Stockpiles on	Monthly for	DSMC in

Field	Location	Responsible for Mitigation	Monitoring of Mitigation	Method of Monitoring	Indicators/ Standards	Frequency	Responsible for Monitoring
	sites and areas designated for stockpiling of materials	Contractor	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 (SO_2), nitrous oxides (NOx), carbon monoxide (CO), and hydrocarbons (HC)	records; (ii) visual inspection of sites	designated areas only; (ii) complaints from sensitive receptors satisfactorily addressed; (iii) air pollution control devices working properly; (iv) GOI Ambient Quality Standards for ambient air quality; (v) GOI Vehicular Emission Standards for SO_2, NOx, CO and HC.	checking records	coordination with Pollution Control Board
Surface Water Quality	(i) Construction sites; (ii) areas for stockpiles, storage of fuels and lubricants and waste materials;	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	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) GOI Standards for Water Discharges to Inland Waters	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
			inspection; (iv) effectiveness of water management measures; (v) for inland water: suspended solids, oil and grease, biological oxygen demand (BOD), and coliforms.		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
Existing Utilities and Infrastructure	Construction sites	Construction Contractor	(i) Existing Utilities Contingency Plan	(i) Checking of records; (ii) visual inspection	Implementation according to Utilities Contingency Plan	As needed	DSMC
Landscape and Aesthetics	(i) Construction sites; (ii) areas for stockpiles, storage of fuels and lubricants and waste materials; (iii) work camps	Construction Contractor	(i) Waste Management Plan; (ii) complaints from sensitive receptors; (iii) SIPMIU/DSMC to report in writing that the necessary	(i) Checking of records; (ii) visual inspection	(i)No accumulation of solid wastes on-site; (ii) implementation of Waste Management Plan; (iii) complaints from sensitive	Monthly	DSMC

Field	Location	Responsible for Mitigation	Monitoring of Mitigation	Method of Monitoring	Indicators/ Standards	Frequency	Responsible for Monitoring
			environmental restoration work has been adequately performed before acceptance of work.		receptors satisfactorily addressed.		
Accessibility	(i) Construction sites; (ii) traffic haul road	Construction Contractor	(i) Traffic Management Plan; (ii) complaints from sensitive receptors; (iii) 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 Aizwal equal or greater than 50% of total workforce	Quarterly	DSMC
Occupational Health and	construction sites	Construction Contractor	(i) Site-specific Health and	(i) Checking of records;	(i) Implementation of H&S plan;	Quarterly	DSMC

Field	Location	Responsible for Mitigation	Monitoring of Mitigation	Method of Monitoring	Indicators/ Standards	Frequency	Responsible for Monitoring
safety			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 high voltage	(ii) visual inspection	(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		

Field	Location	Responsible for Mitigation	Monitoring of Mitigation	Method of Monitoring	Indicators/ Standards	Frequency	Responsible for Monitoring
			equipment, and areas for storage and disposal.				
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 addressed	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 20: Operation and Maintenance Environmental Monitoring Program (Approach Road)

Field	Location	Responsible for Mitigation	Monitoring of Mitigation	Method of Monitoring	Indicators/ Standards	Frequency	Responsible for Monitoring
Drinking Water Quality	Random sample form domestic users along the approach road	PHED and O&M Contractors	Comparison with BIS & IMC standard	Sample collection and laboratory analyses	Indicators \ Standard set by BIS or IMC	Quarterly or as prescribed by BIS or IMC	PHED Mizoram
Surface water Quality	Surface water Body situated along the approach road.	PHED and O&M Contractors	Comparison with Surface Water Quality Standard of CPCB, MOEF	Sample collection and laboratory analyses	Indicators \ Standard set by CPCB	Quarterly or as prescribed by SPCB Mizoram	PHED Mizoram
RPM	Maintenance site	PHED and O&M Contractors	Comparison with RPM limits in NAAQM	Sample collection and laboratory analyses	Standard set by CPCB	Quarterly or as prescribed by CPCB	PHED Mizoram
Noise Level	Maintenance site	PHED and O&M Contractors	Comparison with Noise level limits in NANQM	Sample collection and laboratory analyses	Standard set by CPCB	Quarterly or as prescribed by CPCB	PHED Mizoram
Occupational Health and safety	subproject location	PHED and O&M Contractors	Complaints from sensitive receptors	(i) Records of training; (ii) H&S Plan approved by PHED	Complaints from sensitive receptors satisfactorily addressed	As needed	PHED Mizoram
General Maintenance	subproject location	PHED and O&M Contractors	Complaints from sensitive receptors	Checking of records	Complaints from sensitive receptors satisfactorily addressed	As needed	PHED Mizoram
Community Health and safety	subproject location	PHED and O&M Contractors	Complaints from sensitive receptors	Checking of records	complaints from sensitive receptors satisfactorily addressed	As needed	PHED Mizoram

CPCB = Central Pollution Control Board, O&M = operation and maintenance, PHED = Public Health and Engineering Department, UD&PAD = Urban Development & Poverty Alleviation Department. NAAQM = National Ambient Air Quality Monitoring NANQM = National Ambient Noise Quality Monitoring, BIS= Bureau of Indian standard, IMC = Indian Medical Council, RPM= Respirable Particulate Matter

F. Environmental Management Plan Costs

176. Most of the mitigation measures require the construction contractors to adopt good site practice, which should be part of their normal procedures already, so there are unlikely to be major costs associated with compliance. Regardless of this, any costs of mitigation by the construction contractors or DSMC are included in the budgets for the civil works and do not need to be estimated separately. Mitigation that is the responsibility of UDD will be provided as part of their management of the project, so this also does not need to be duplicated here.

177. The remaining actions in the EMP are the various environmental monitoring activities. These have not been budgeted elsewhere, and their costs are shown in Table 20. The figures show that the total cost of environmental management and monitoring for the subproject as a whole (covering design, 3.5 years of construction and one year of operation under the defect liability period).

Table 21: Environmental Management and Monitoring Costs (INR)

Item	Total Cost (INR crore)	Source of Funds
Environment Management Cost	9.60	
Mitigation Measures (pre-construction)	to be determined	SIPMIU Cost
Mitigation Measures (construction)	to be determined	Construction Contractors Cost
Mitigation Measures (O&M)	to be determined	PHED Cost
Monitoring Measures (Pre-construction)	to be determined	DSMC Cost
Monitoring Measures (Construction)	-	Construction Contractor Cost
Monitoring Measures (O&M)	to be determined	PHED Cost
a. Effluent Monitoring (annual)	to be determined	
b. Sludge Monitoring (annual)	to be determined	
Tree plantation (after construction)	to be determined	SIPMIU Cost
Maintenance of tree plantations (3 years)	to be determined	SIPMIU Cost
Capacity Building (Total)	4.7	SIPMIU Cost
Training Sessions (pre-construction)	to be determined	SIPMIU Cost
Training Sessions (construction)	to be determined	SIPMIU Cost

IX. FINDINGS AND RECOMMENDATIONS

178. The environmental impacts of elements of the infrastructure proposed under the Aizawl Water Supply were assessed. Potential negative impacts were identified in relation to both construction and operation of the improved infrastructure, but no major impacts were identified as being due to either the project design or location. Mitigation measures have been developed in generic way 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.

179. During the construction phase, impacts mainly arise from the need to dispose of large quantities of waste soil and import a similar amount of materials to support the pipes in the trenches; and from the disturbance of residents, businesses, traffic and important buildings by

the construction work. These are common impacts of construction in urban areas, and there are well developed methods for their mitigation.

180. Once the system is operating, most facilities will operate with routine maintenance, which should not affect the environment. Leaks in the water supply network will need to be repaired from time to time, but environmental impacts will be much less than those of the construction period as the work will be infrequent, affecting small areas only. It will also be conducted in areas that have already been excavated, so there will be no need to protect archaeological material.

181. The main impacts of the operating water supply system will be beneficial as the citizens of Aizawl will be provided with a constant supply of water, which will serve a greater proportion of the population. The main impacts of the operating water treatment plant will be beneficial as a sufficient amount of water will be supplied and treated to an acceptable standard. This will improve the environment and appearance of these areas, and the health and quality of life of the citizens. Water borne diseases will be reduced, which should lead to economic gains as people will be away from work less and will spend less on healthcare, so their incomes should increase.

182. Mitigation will be assured by a program of environmental monitoring conducted during both construction and operation to ensure that all measures are provided as intended, and to determine whether the environment is protected as envisaged. 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 longer-term surveys to monitor the quality of treated water and health status in vicinity of the facility.

X. CONCLUSIONS

183. 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.

184. 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 GoI EIA Notification (2006).

APPENDIX 1: ADB RAPID ENVIRONMENTAL ASSESSMENT CHECKLIST FOR WATER SUPPLY

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. The area is predominantly residential.
• 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…			
• Pollution of raw water supply from upstream wastewater discharge from communities, industries, agriculture, and soil erosion runoff?		✓	Not anticipated. There are no human habitations, industries and agricultural activities upstream of water source. The existing environmental condition of the water source (Tlawng River) is good. Areas upstream of the source are undisturbed. As vegetation in the subproject area is good, soil erosion runoff draining towards the water source is insignificant.
• 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 subproject sites.
• Hazard of land subsidence caused by excessive ground water pumping?		✓	Not applicable.
• Social conflicts arising from displacement of communities?		✓	No displacement required. Subproject sites are government-owned. Temporary impacts to businesses may occur during pipelaying works and are to be addressed through specific measures in the EMP. Any involuntary resettlement impacts identified will be addressed in the RP.
• Conflicts in abstraction of raw water for water supply with other beneficial water uses for surface and ground waters?		✓	Not anticipated. Groundwater will not be used as source. Per Government of Mizoram Irrigation Department, the average annual maximum discharge of the water source (Tlawng River) is about 448.35 MLD (183 cusec) during

Screening questions	Yes	No	Remarks
			post–monsoon). At the intake site, minimum discharge during lean season/pre-monsoon, as measured by the Irrigation Department, is 262.15 MLD (107 cusec). Therefore water quantity is sufficient and abstraction of 37 MLD from the river will not have significant impact.
• Unsatisfactory raw water supply (e.g. Excessive pathogens or mineral constituents)?		✓	Not anticipated. Monitoring and analysis conducted by Mizoram Irrigation Department, Public Health and Engineering Department (PHED), and SIPMIU on raw water from the water sources indicate water quality parameters are within prescribed limits.
• Delivery of unsafe water to distribution system?		✓	Not anticipated. Subproject includes rehabilitation of existing and construction of distribution network. Any distributed water will be treated and ensured to comply with the National Drinking Water Quality Standards.
• Inadequate protection of intake works or wells, leading to pollution of water supply?		✓	Not anticipated. Subproject includes fencing and other protection work for water intakes.
• Over pumping of ground water, leading to salinization and ground subsidence?		✓	Not applicable. Groundwater will not be used as source.
• Excessive algal growth in storage reservoir?		✓	Not anticipated. Storage reservoirs are only for treated water. The water is chlorinated and the reservoirs covered to prevent algal growth.
• Increase in production of sewage beyond capabilities of community facilities?		✓	NERCCDIP Project 3 will improve the existing collection and treatment systems by providing additional cesspool equipment and pilot-study of decentralized septage management.
• Inadequate disposal of sludge from water treatment plants?		✓	WTP sludge to be disposed in Aizawl municipal SLF.
• Inadequate buffer zone around pumping and treatment plants to alleviate noise and other possible nuisances and protect facilities?		✓	Not applicable. Buffer zones included in designs of WTPs.
• Impairments associated with transmission lines and access roads?		✓	Not anticipated. Road closures are not required during pipelaying works. A section-wise approach will limit impairments to traffic and businesses during construction. The EMP ensures measures are included to mitigate the impacts.
• Health hazards arising from inadequate design of facilities for receiving, storing, and handling of chlorine and other hazardous chemicals.		✓	Not anticipated. WTP designs include dedicated areas for chemical storage. Workers will be trained on proper chemical handling and emergency response

Screening questions	Yes	No	Remarks
			procedures.
• Health and safety hazards to workers from handling and management of chlorine used for disinfection, other contaminants, and biological and physical hazards during project construction and operation?		✓	Not anticipated. During construction, workers will be required to undergo health and safety induction course prior to mobilization to construction sites. During O&M, workers will be trained on proper chemical handling and emergency response procedures.
• Dislocation or involuntary resettlement of people?		✓	No involuntary resettlement impacts envisioned. Lands for the subproject are government-owned. Any involuntary resettlement impacts identified will be addressed in the RP.
• Disproportionate impacts on the poor, women and children, indigenous peoples or other vulnerable groups?		✓	Not anticipated. The contractor will be encouraged to hire local workers from the local labor force.
• 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 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.
• Increased road traffic due to interference of construction activities?	✓		Anticipated during construction activities. The impacts are negative but short-term and site-specific within a relatively small area and reversible through mitigation measures. Traffic management will be specified in the EMP.
• Continuing soil erosion/silt runoff from construction operations?	✓		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.
• Delivery of unsafe water due to poor O&M treatment processes (especially mud accumulations in filters) and inadequate chlorination due to lack of adequate monitoring of chlorine residuals in distribution systems?		✓	The project will include development of O&M manuals to ensure facilities are kept in working condition, including maintenance of filters and monitoring of disinfection/chlorination system. Any distributed water must comply with the National Drinking Water Quality Standards.
• Delivery of water to distribution system, which is corrosive due to inadequate attention to feeding of corrective chemicals?		✓	The project will include development of O&M manuals to ensure facilities are kept in working condition, including checking and maintenance of distribution network. Any distributed water must comply with

Screening questions	Yes	No	Remarks
			the National Drinking Water Quality Standards.
• Accidental leakage of chlorine gas?		✓	Not applicable. Chlorine gas will not be used.
• Excessive abstraction of water affecting downstream water users?		✓	Not anticipated. Groundwater will not be used as source. Per Government of Mizoram Irrigation Department, the average annual maximum discharge of the water source (Tlawng River) is about 448.35 MLD (183 cusec) during post–monsoon). At the intake site, minimum discharge during lean season/pre-monsoon, as measured by the Irrigation Department, is 262.15 MLD (107 cusec). Therefore water quantity is sufficient and abstraction of 37 MLD from the river will not have significant impact.
• Competing uses of water?		✓	
• Increased sewage flow due to increased water supply	✓		NERCCDIP Project 3 will improve the existing collection and treatment systems by providing additional cesspool equipment and pilot-study of decentralized septage management.
• Increased volume of sullage (wastewater from cooking and washing) and sludge from wastewater treatment plant	✓		
• Large population influx during project construction and operation that causes increased burden on social infrastructure and services (such as water supply and sanitation systems)?		✓	Improved management systems through capacity building and institutional development will ensure reduced burden on services and infrastructure.
• Social conflicts if workers from other regions or countries are hired?		✓	Priority in employment will be given to local residents.
• 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 operation and construction?		✓	Not applicable. Construction will not involve use of explosives and chemicals.
• Community safety risks due to both accidental and natural hazards, especially where the structural elements or components 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?		✓	Work areas will be clearly demarcated with signage and safety barriers, and access will be controlled. Only workers and project concerned members will be allowed to visit the operational sites.

Screening Questions		Score	Remarks[8]
Location and	Is siting and/or routing of the project (or its	0	All pipes will be

[8] 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.

Design of project	components) likely to be affected by climate conditions including extreme weather related events such as floods, droughts, storms, landslides?		constructed below ground, no components will be sited 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	Proposed investments will not pass through major cross drainages and river. Pipes 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:

Response	**Score**
Not Likely	0
Likely	1
Very Likely	2

Responses when added that provide a score of 0 will be considered low risk project. If adding all responses will result to a score of 1-4 and that no score of 2 was given to any single response, the project will be assigned a medium risk category. A total score of 5 or more (which include providing a score of 1 in all responses) or a 2 in any single response will be categorized as high risk project.

Result of Initial Screening (Low, Medium, High): Low Risk

APPENDIX 2: GRIEVANCE REDRESSAL COMMITTEE (STATE LEVEL)

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

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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.**

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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.

SAMPLE GRIEVANCE REDRESS FORM

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: 1. Note/Letter 2. E-mail 3. Verbal/Telephonic	
Reviewed by: (Names/Positions of Official(s) reviewing grievance)	
Action Taken:	
Whether Action Taken Disclosed: 4.	Yes No
Means of Disclosure:	

APPENDIX 3: CONSENT TO ESTABLISH (NOC) for 37 MLD WTP

OFFICE OF THE MIZORAM STATE POLLUTION CONTROL BOARD
AIZAWL: MIZORAM

CONSENT TO ESTABLISH
(NO OBJECTION CERTIFICATE)

No.H.88088/Poltn/9 (238)/2015-MPCB/NO : Dated Aizawl, the 16th April, 2015

CONSENT TO ESTABLISH (NO OBJECTION CERTIFICATE) is hereby granted to **M/S SIPMIU, MIZORAM** for setting up of **WATER TREATMENT PLANT 37 MLD** at **Tanhril, Mizoram** having an installed production capacity of **37 MLD** 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. W.11046/2/2011-PD/SIPMIU (NERCCDIP)/37 dated 13.2.2015 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. ***Chlorine gas is very poisonous and corrosive. The cylinders and containers of chlorine should be stored in a dry enclosure or building.***
5. 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.
6. Efforts shall have to be made by the industry for recycle and recovery of waste to the maximum extent possible.
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.
9. This certificate will remain valid for a period of 1(one) year from the date of issue.

MIZORAM STATE POLLUTION CONTROL BOARD MIZORAM mpcb

(C.LALDUHAWMA)
Member Secretary

Memo No.H.88088/Poltn/9 (238)/2015-MPCB/ : Dated Aizawl, the 16th April, 2015

Copy to: The Project Director, SIPMIU, Government of Mizoram & Proprietor, **WATER TREATMENT PLANT 37 MLD, TANHRIL, MIZORAM** with reference to the application No. W.11046/2/2011-PD/SIPMIU (NERCCDIP)/37 dated 13.2.2015.

(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 4: PHOTOGRAPHS DURINNG CONSULTAION

Consultation with residents

Consultation with Landowner of Reservoir site at Tuivamit Mr. P.C. Lallianthanga SP, MPRO Govt. Of Mizoram

Public Consultation: Explaining the Project

Public Consultation: Explaining the Project

APPENDIX 5: NOC FOR CONSTRUCTION OF WATER RESERVOIR ON DONATED LAND AT TUIVAMIT.

Land Donation Agreement

37

Land Donation Agreement

This Land Donation Agreement ('Agreement") is made as of 13th February 2015 by and between **Mr. P.C. Lallianthanga, New Capital Complex, Aizawl, Mizoram** hereinafter referred to as "Donor" and **Project Director**, State Investment Programme Management Implementation Unit (SIPMIU) NERCCDIP Govt. of Mizoram, Aizawl Mizoram hereinafter referred to as "Recipient"

Whereas, Donor generously agreed to donate a portion of land his land from the land pass no. LSC No. Azl- 2838 of 2986 situated at Tuivamit Veng, Aizawl Mizroam for the construction of 400KL capacity RCC tank with feeder main pipeline.

The followings points agreed by Parties:-

1. Existing approach road to the donated land for reservoir construction is an earthen road (kachha) and shall be developed to metal (pacca) road by the Recipient.
2. Approach road up to the reservoir will be used freely by the Recipient's employees, contractors during construction and later by PHED who will take charge of maintenances and operations of the reservoir.
3. Reservoir will be handed over to PHED after completion of work.
4. Donor shall not restrict or limit any concerned/authorized person's access to the reservoir location.
5. Donor will be provided with water connections after completion of reservoir.
6. Donor shall not restrict or limit installation of pipeline within his premises from the reservoir for distribution purpose to public.
7. Ownership of the land shall be transferred to PHED. All cost/Fee for transfer of ownership shall be paid by Recipient including all office dealings and other requirements for ownership transfer.
8. Donor reserves back the right of ownership of the said land if structure other than water reservoir may/or is proposed in future.

RACIPIENT 13/2/2015
(VALBUANGA)
Project Director, SIPMIU
Govt. of Mizoram, Aizawl
Dt.....

DONOR 13/2/15
(P.C LALLIANTHANGA)
Land Owner
New Capital Complex, Aizawl
Dt.....

Witnesses:

1) Name: LALTHANZUALI Signature..... Address..... Dy. P.D. SIPMIU
2) Name: RINZAMLOVA Signature..... Address.....
3) Name K. ROCHHUAKA Signature..... Address.....
4) Name ROTLUPUII Signature..... Address.....

Dy. Project Director (T)
SIPMIU (NERCCDIP)
Aizawl : Mi...

Deputy Director of Survey,
Land Revenue & Settlement
Mizoram : Aizawl

Chairman
Tuivamit Local Council
Aizawl

Sub -Divisional Officer, PHED
Aizawl Water Distribution
Sub -Division, North - II

APPENDIX 6: (A) DISCHARGE OF TLAWNG RIVER AT REIEK BRIDGE FOR 25 YEARS

GOVENRMENT OF MIZORAM
MINOR IRRIGATION DEPARTMENT
MIZORAM : AIZAWL

This is to certified that the discharge of River Tlawng from October,1975 to November, 2000 measured at Reiek Bridge are as follows :-

Time		Discharge in Cusecs
10.10.1975	-	186 cusecs
24.10.1975	-	193 cusecs
07.11.1975	-	154 cusecs
21.11.1975	-	152 cusecs
05.12.1975	-	146 cusecs
19.12.1975	-	154 cusecs
09.01.1976	-	148 cusecs
30.01.1976	-	141 cusecs
13.02.1976	-	139 cusecs
27.02.1976	-	150 cusecs
08.03.1976	-	137 cusecs
19.03.1976	-	121 cusecs
22.04.1976	-	128 cusecs
21.05.1976	-	151 cusecs
15.01.1977	-	132 cusecs
20.12.1977	-	130 cusecs
30.01.1978	-	126 cusecs
06.02.1978	-	120 cusecs
14.03.1978	-	123 cusecs
15.11.1978	-	134 cusecs
23.01.1979	-	136 cusecs
19.03.1979	-	128 cusecs
17.10.1979	-	140 cusecs
15.12.1979	-	143 cusecs
16.03.1980	-	160 cusecs
12.12.1980	-	156 cusecs
03.06.1981	-	148 cusecs
08.11.1981	-	143 cusecs
07.03.1982	-	136 cusecs
06.10.1982	-	125 cusecs

Cont../-

12.02.1983	-	119 cusecs
17.12.1983	-	105 cusecs
30.03.1984	-	100 cusecs
29.11.1984	-	104 cusecs
30.01.1985	-	108 cusecs
26.10.1985	-	113 cusecs
16.03.1986	-	109 cusecs
17.12.1986	-	120 cusecs
11.02.1987	-	126 cusecs
09.09.1987	-	130 cusecs
10.01.1988	-	127 cusecs
31.11.1988	-	118 cusecs
24.02.1989	-	116 cusecs
30.09.1989	-	123 cusecs
02.02.1990	-	114 cusecs
01.12.1990	-	110 cusecs
03.10.1991	-	106 cusecs
02.03.1992	-	104 cusecs
03.11.1993	-	102 cusecs
04.03.1994	-	107 cusecs
26.02.1995	-	108 cusecs
26.12.1996	-	113 cusecs
15.02.1997	-	135 cusecs
16.09.1998	-	162 cusecs
17.02.1999	-	160 cusecs
23.11.2000	-	183 cusecs

The discharge was measured using Area-velocity method.

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APPENDIX 6: (B) DISCHARGE OF TLAWNG RIVER AT REIEK BRIDGE FOR 25 YEARS

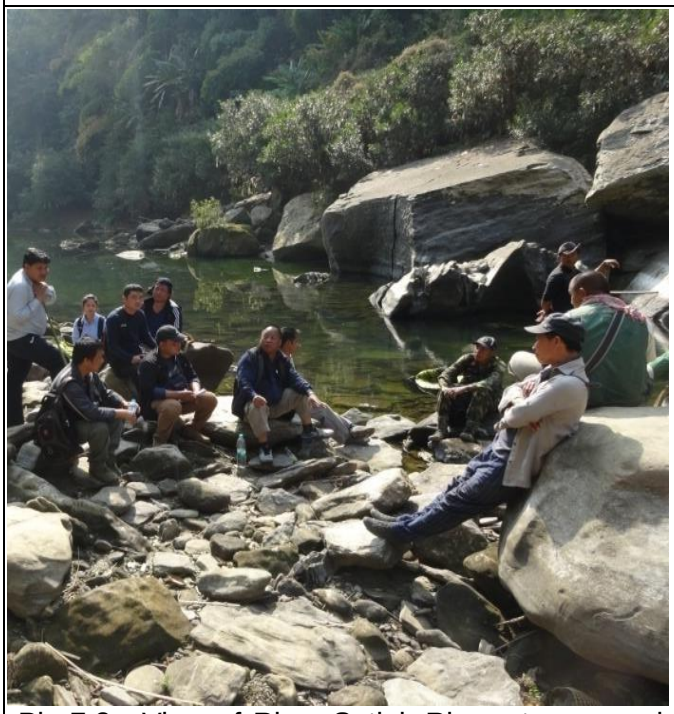
Discharge of Twalng River at Reiek Bridge (Up - Stream Flow) for 25 Years			
Sl no	Time	Discharge in Cusecs	Discharge in MLD
1	10.10.1975	186	455.70
2	24.10.1975	193	472.85
3	7.11.1975	154	377.30
4	21.11.1975	152	372.40
5	5.12.1975	146	357.70
6	19.12.1975	154	377.30
7	9.01.1976	148	362.60
8	30.01.1976	141	345.45
9	13.02.1976	139	340.55
10	27.02.1976	150	367.50
11	8.03.1976	137	335.65
12	19.03.1976	121	296.45
13	22.04.1976	128	313.60
14	21.05.1976	151	369.95
15	15.01.1977	132	323.40
16	20.12.1977	130	318.50
17	30.01.1978	126	308.70
18	6.02.1978	120	294.00
19	14.03.1978	123	301.35
20	15.11.1978	134	328.30
21	23.01.1979	136	333.20
22	19.03.1979	128	313.60
23	17.10.1979	140	343.00
24	15.12.1979	143	350.35
25	16.03.1980	160	392.00
26	12.12.1980	156	382.20
27	3.06.1981	148	362.60
28	08.11.1981	143	350.35
29	7.03.1982	136	333.20
30	6.10.1982	125	306.25
31	12.02.1983	119	291.55
32	17.12.1983	105	257.25
33	30.03.1984	100	245.00
34	29.11.1984	104	254.80
35	30.01.1985	108	264.60
36	26.10.1985	113	276.85
37	16.03.1986	109	267.05
38	17.12.1986	120	294.00
39	11.02.1987	126	308.70
40	9.09.1987	130	318.50
41	10.01.1988	127	311.15
42	31.11.1988	118	289.10
43	24.02.1989	116	284.20
44	30.09.1989	123	301.35

45	2.02.1990	114	279.30
46	1.12.1990	110	269.50
47	3.10.1991	106	259.70
48	2.03.1992	104	254.80
49	3.11.1993	102	249.90
50	4.03.1994	107	262.15
51	26.02.1995	108	264.60
52	26.12.1996	113	276.85
53	15.02.1997	135	330.75
54	16.09.1998	162	396.90
55	17.02.1999	160	392.00
56	23.11.2000	183	448.35

APPENDIX 7: SOME PICTURES OF PROPOSED APPROACH ROAD, WATER INTAKE SITE AND WTP SITE WITH ASSOCIATED BUILDINGS

Pic 7.1 : Proposed Approach Road Alignment

Pic 7.2 : View of River Twalng at Proposed Intake Site



Pic 7.3 : View of River Setlak River at proposed Minor Bridge Site for Approach Road

Pic 7.4: Proposed Site for WTP & Clear Pump House No 1 and other building structures.