

C - Environmental Management Plan

Introduction

The Kerala Solid Waste Management Project (KSWMP) aims to modernize the state's waste management systems through a structured, three-pillar approach. KSWMP provides technical assistance to state and local bodies, alongside skilling, training, and public awareness campaigns. The Project delivers direct financial grants to Urban Local Bodies (ULBs) to upgrade their specific waste systems and operational capacities. Financing the construction and remediation of shared regional facilities that serve multiple municipalities, including the closure of old dumpsites and recovering the valuable land through biomining.

The Kerala Solid Waste Management Project invited online proposals from eligible bidders for the Design and Build Work of Bio-mining and Bio-remediation of legacy waste dumpsite (approx. 2,30,995 m³ of waste over 17.5 acres) at Njeliyanparamba, Kozhikode, Kerala. Zigma Global Environ Solutions Private Limited has won the project.

Kozhikode and the Challenge of Urban Waste

Kozhikode, historically celebrated as the "City of Spices" and more recently recognized as a UNESCO City of Literature, stands as a vital cultural and economic hub on Kerala's Malabar Coast. From its legacy as a global trade center where Vasco da Gama first landed in 1498 to its modern status as a center for world-class cuisine and literature, the city is managed by the Kozhikode Corporation—the oldest municipal corporation in Kerala.

However, like many rapidly growing urban centers in India, Kozhikode faces the mounting pressure of sustainable waste management. The environmental and socio-economic impact of traditional dumpsites presents a significant challenge:

Environmental Degradation

Unlike engineered landfills in developed nations, Indian dumpsites often lack liners and gas collection systems, leading to toxic leachate contaminating groundwater and the release of methane, a potent greenhouse gas.

Public Health Risks

These sites act as breeding grounds for vector-borne diseases and are prone to spontaneous combustion. Major incidents in cities like Mumbai and Delhi underscore the severe air quality crises caused by dumpsite fires.

Ecological Impact

With over 60% of Indian dumpsites located near water bodies, the runoff poses a direct threat to aquatic ecosystems and local flora and fauna.

Transitioning toward scientific waste management is no longer just an infrastructure goal, but a necessity for protecting the public health and the vibrant heritage of cities like Kozhikode.

C-Environmental Management Plan

a. Impacts and mitigation measures planning and installation phase

S. No. (1)	Activity/ Probable Impacts (2)	Recommended Mitigation Measures (3)	Contractor's mitigation measures (4)	Responsibility (5)
1	Biomining & Bioremediation Plan & Capacities	▪ Contractor to prepare & follow Disaster/Emergency Response Plan, a detailed Fire Safety Plan, Pests/Flies, Odour and Leachate Management Plan, Storm water management plan, and Asbestos management plan. ▪ The contractor should have qualified & experienced environmental health & safety personnel during all days to manage EHS & EMP and for verifying its compliance as per the updated Plans. ▪ Contractor to get all required licenses & permits before start of any activity on site ▪ In case any other site is considered additionally for this subproject, EIA, EMP, & CEMP shall be updated and followed.	• Zigma will prepare, implement, and regularly update all required plans, including Disaster/Emergency Response Plan, Fire Safety Plan, Pest/Fly Control Plan, Odour Management Plan, Leachate Management Plan, Storm Water Management Plan, and Asbestos Management Plan, and ensure effective implementation at site. • Will deploy qualified and experienced EHS personnel at all times, responsible for implementation, monitoring, and compliance of EMP/CEMP and all EHS requirements throughout the project duration. • Will obtain all required licenses, approvals, and permits prior to commencement of any activity and ensure compliance with all statutory	Contractor

			conditions throughout the project. • Will update and implement EMP/CEMP for any additional considered, obtain necessary approvals, and ensure full compliance with applicable environmental and social requirements. • Any future allocated dumpsite will follow procedures as mentioned in tender documents,	
2	Site Access Closure	▪ The total cessation of dumping in the site shall be implemented before any works. ▪ All public access to the site, including waste pickers and scavengers should be prohibited via adequate fencing/compound wall, manned security, information to communities around and signage which prohibit public access completely, to avoid risk to the public. ▪ The activities of existing RRF and windrow facilities shall not be affected by the biomining operations. Necessary access control should be ensured with protective fencing, barricades, and signages. ▪ To avoid land disturbance and movement, the fence/compound wall shall generally follow the contour of the ground. Grading shall be performed where necessary to provide a neat appearance	• Zigma will ensure dumping is stopped at allocated dumpsite before commencement of biomining works. • Will restrict public access through proper, security checkpoint arrangements, signage, CCTV and community awareness. • Will ensure existing RRF and windrow operations are not affected by maintaining access control and protective measures. • Will align fencing with ground contours and carry out minimal grading for stability and neatness. The information/ communication to the communities shall be done in presence of all the stakeholders. KSWMP and KMC to facilitate the same.	ULB or Contractor as per Bidding mechanism
3	Absence / Delay	▪ Required permissions for undertaking biomining at the	CTE/CTO applied.	Contractor,

	in Permissions for Developing the biomining facility and associated works as per National regulations	existing dumpsite and assessments conducted for undertaking biomining as per existing Laws & Regulations; including for associated infrastructure, DG Sets, Integrated Consent To Operate; and other licenses including those as per Labour Laws, before the start of works on site.		ULB
4	Site assessments including soil boring, auger and test pit, or standard penetration tests for assessing the contamination of the waste – <i>impact on air quality, odor, water contamination due to leachate, health and safety impacts of the people working in the site assessment</i>	▪ Carry out site assessments as per Guidelines for Biomining of Legacy waste Dumpsites, CPCB 2019. ▪ Follow all safety measures during biomining at the existing covered waste in the site to prevent gas/leachate generation. ▪ Provision of appropriate PPE's to the team undertaking the site assessments. ▪ Ensure that waste samples are taken in a manner that does not greatly disturb the matrix of the existing waste mound. Ensure proper barricades while working on the pit and proper backfilling of test pits ▪ Assess the contamination test before using the fractions on site to comply with the screening levels of MoEFCC 2015, and if any isolated samples show higher levels, that should be safely disposed of at KEIL. • Care should be maintained, especially when working on the slopes to ensure further failures do not occur due to the height of the mound. ▪ Plan for machinery operated which will be operated by skilled operators at all times. ▪ Arrange adequate PPEs full-body suits, masks, helmets,	• Zigma will carry out site assessments as per CPCB 2019 biomining guidelines. • Will implement all safety measures during biomining, and manage unavoidable leachate generated from legacy waste as per CPCB guidelines. • Will provide mandatory PPE for regular and job-specific activities to all personnel. • Will ensure safe sampling with minimal disturbance, proper barricading, and backfilling of test pits. • Will conduct contamination testing as per MoEFCC 2015 and dispose of non-compliant waste at KEIL. • Will ensure slope stability and take precautions to prevent failures during operations. • Will deploy only skilled and trained	ULB/ Contractor

		boots and gloves, and heat protection equipment to avoid exposure with raw decomposing waste material, which can be at higher temperatures. a) Excavation work shall be planned and scheduled with information to concerned authorities and host communities – to follow a sequenced manner, to avoid ad-hoc exposed areas of the waste mound	operators for machinery operation. - Will provide full-body PPE including suits, masks, helmets, gloves, boots, and heat protection. - Will plan excavation in a sequenced manner with prior information to authorities and communities. - Will conduct community communication in coordination with KSWMP in presence of relevant stakeholders.	
5	Dust impacts due the Site works, Screening & stacking of retrieved wastes (Air Pollution) and Visual Blight due to excavation	- Plan to Provide temporary high screen buffers around the site before the start of work to curtail dust emissions. - Do not cut the existing trees provided as a green belt around the site. Additionally, provide a GI sheet barricade to prevent wind erosion. Schedule use of bioremediation soil/compost from site to grow the green belt (preferably fast-growing thick canopies of indigenous trees, shrubs in layers) - PPEs to be used by workers. - Awareness to communities & suggest to use PPEs.	- Zigma will install temporary green net fencing, and carry out frequent water sprinkling to control dust emissions. - Will retain the existing green belt, avoid tree cutting, install green net temporary barricades, and promote green belt development using site compost. - Will ensure mandatory use of PPE by all workers. - Will conduct community awareness in coordination with KSWMP in the presence of relevant stakeholders.	Contractor and or ULB depending on agreement on bidding mechanism /DPR
	Material sourcing, transport, and	- Prior intimation to neighbors on proposed construction activities, timings, emergency contacts, grievance mechanism - Prior intimation to nearby Primary Health Centre on work	Zigma will provide prior intimation to nearby communities on activities, timings, emergency contacts, and	Contractor

6	Stacking of construction materials <i>(Occupational Health and Safety issues and Air noise pollution)</i>	activities need for medical support, emergency support needs, type of labourers on-site and labour camp if any ▪ Materials shall be sourced only from approved quarries ▪ Material shall be transported only in closed trucks with PUC certificates, with water sprinkling if required to curtail dust emissions. ▪ The driver should have required license and follow speed regulations ▪ Materials shall be transported preferably through well-surfaced roads. If road is kuchcha, water sprinkling shall be done to prevent dust emission before and after truck passes ▪ Material transport and unloading activities should not result in noise disturbance to locals and should be during day time ▪ Materials shall not be spread around on site. It shall be properly stored/stacked following good housekeeping practices (labeling, properly arranged); in covered sheds to prevent loss of strength and loss of material. Material storage shall not result in any harm to workers or visitors. ▪ vehicle wheel wash area existing on the site ▪ Workers to be provided with Personnel Protection Equipment (PPE) including safety boots, jackets, ear muffs, gloves. ▪ Proper rest area on site shall be provided with water, first aid, toilets	grievance mechanism in coordination with KSWMP. • Will inform the nearby Primary Health Centre in advance regarding major site activities (most critical activities), workforce details, and emergency support requirements. • Will source materials only from approved quarries. • Will transport materials in covered vehicles with green net with valid PUC, and carry out water sprinkling as required to control dust. • Will ensure all drivers are licensed and comply with speed and safety regulations. • Will use designated roads for transport and undertake water sprinkling on unpaved roads to control dust. • Will schedule transport and unloading activities during daytime to minimize disturbance to local communities; for any urgent or unavoidable work beyond these hours, prior consultation will be undertaken with KSWMP. • Will ensure proper storage and stacking of materials with good	
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7	The layout of Labour camp (Impacts on Air, Water, Land, Fauna/Flora, Socio-economic)	▪ Labour camp layout, design and material/fire safety plan shall be approved by site engineer before start of construction of the camp. ▪ Nearby health centre shall be informed about the labour camp & appropriate medical checkup shall be arranged periodically ▪ Materials used for the camp shall be safe (from corrosion, fire/flood/other manmade and natural disasters) ▪ It should not be provided in the waste dumping yard compound. There shall be proper permission & written agreement with land owners wherever the labour is accommodated ▪ Camp must not be provided in an area prone to Hazards	Zigma will provide labour accommodation outside the site premises within nearby communities, ensuring adequate living conditions.	Contractor

		▪ Camp should be adequately at higher plinth levels to prevent water intrusion ▪ Rooms shall be of appropriate sizes with adequate ventilation and livable temperature/other conditions and facilities like proper beds, storage areas, common kitchen where wood or unsafe fuels are not used (better to use LPG) ▪ Proper facilities shall be provided at the camp including food and common entertainment facilities, crèche (in case of female labourers- as in regulations), toilets with proper septic tanks, washing area, wastewater, and waste collection/management systems, etc. ▪ The camp shall be planned / designed to be maintained in good clean hygienic conditions and shall have outdoor seating areas, greenery, security (Refer ECoP section 06 and section 11 of EMF for KSWMP)		
8	Nearness/disturbance to sensitive areas such as forests, wildlife habitations, etc. especially in case of providing support facilities <i>(Impacts on Fauna / Flora)</i>	▪ Ensure site selection for any support facilities or activities (such as vehicle storage etc. if not in bio - mining site) based on the screening checklist and the master plan of the region, to avoid sensitive areas. Follow mitigation hierarchy – Avoid, Minimize, Mitigate, Reduce. Obtain requisite permissions from respective authorities such as Pollution Control Board, ULB etc. ▪ Identify appropriate government site to avoid land acquisition and resettlement impacts ..Covered and well-marked storage area with cut off drains & odour/fly/dust/ fire prevention shall be ensured for excavated	• Zigma will ensure covered and dedicated storage area shall be planned 100 feet away from nearby residences for hazardous material storage/ material storage.	Contractor

		wastes and washing, segregation of the same are to be arranged with due consideration to nearby residences.		
9	Leachate pollution and health impacts	- During the excavation, ensure appropriate design provisions (based on hydrogeological aspects as well) are made for liners, lined drains for leachate collection and leachate treatment facilities to prevent percolation of leachate. Wherever excavated material is stored, it shall be kept on the platform with garland drain to collect leachate and direct it to the treatment plant. - The leachate management plan to be prepared by the contractor shall cover plans for biomining the covered waste area as well. - Contractor shall ensure that no leachate from the existing windrow facility is polluting the biomining area.	- Zigma will maintain the existing collection systems, and will create a drains wherever applicable. - Will prepare and implement a comprehensive leachate management plan, including collection, transportation, treatment (LMU/recirculation/ETP), and monitoring. - Will ensure segregation and control measures so that leachate from existing windrow or adjacent facilities does not contaminate the biomining area.	Contractor
10	Impacts on flora, fauna" due to consumption of wastes, leachate impacts, dust smoke –burning, tramplng/machinery	- Movement routes of vehicles to be planned to avoid impact on key fauna/flora on site such as Ailanthus sp.(Tree) & Funambulus tristriatus (Jungle Palm Squirrel). - Special precautions must be taken to avoid any harm to on-site biodiversity during operations. This includes the installation of bird netting and temporary fences based on site conditions and work schedules. Additionally, visual deterrents such as bird spiders and scarecrows should be employed as deemed appropriate. - Leachate collection & storage/treatment and recirculation shall be ensured to avoid impacts on flora, fauna.	Zigma will plan vehicle movement to minimize disturbance to on-site flora and fauna, implement biodiversity protection measures if any and ensure effective leachate collection, storage, treatment, and recirculation to prevent environmental impacts	Contractor

			▪ Leachate collection storage / treatment and recirculation shall be ensured.	
11	Nuisance hazards to neighboring areas	▪ Ensure proper design and adequate compound wall; high screen during construction in consultation with communities, buffer zones and thick green belt to comply with SWM Rules, 2016 and other PCB requirements ▪ In case of waste, the mound and site edges are sliding or unsafe; provide engineered retention walls. • Implementing a flexible work schedule to accommodate nearby temple festivals, aiming to minimize the impact on the community during the festive period.	• The compound wall exist around the site and green net fencing shall be done between site and residential area • If required, Zigma will adopt flexible work schedules in coordination with stakeholders to minimize impacts during nearby temple festivals.	Contractor
12	Treatment & Disposal of wastes and rejects	• Plan treatment & disposal mechanisms for retrieved wastes & rejects/inerts in line with applicable regulations for each type of waste. Retrieved Legacy Waste, reject & inert disposal plan shall be prepared, submitted to the Engineer for approval. All retrieved material shall be inventoried and quantified, including Bioearth, rejects, inerts. These shall be tested and disposed in line with applicable regulations including Hazardous Waste Management Rules 2016, Biomedical Waste Management Rules 2016, SWM Rules, 2016, C&D waste Rules 206, Plastic Waste Management Rules 2016, Fertiliser Control Order 1985 and their amendments. Asbestos Management Plan shall be	Letter seeking support from KEIL is submitted.	Contractor

		prepared for management of Asbestos wastes retrieved if any ▪ Further storage, treatment or disposal of retrieved legacy wastes or rejects/inerts shall not be in a manner that disturbs any sensitive receptor or area (communities, waterbodies, air, soil, biodiversity etc) in such a way that no material is allowed to remain on site after contract period.		
13	Compost compliance and it forward linkage	▪ Analysis of the fine fraction/the legacy biowaste remaining in the site shall be tested for its compliance with the FCO standard. ▪ Results showed compliance with most parameters except for moisture, EC, potash, and phosphate. Moisture is expected to improve during biomining, while high EC (8 dS/m) and lower nutrient values can be corrected by blending with fresh compost, farmyard manure, or amendments like rock phosphate and wood ash. ▪ The analysis further confirmed that heavy metal levels are within the permissible limits of FCO 2009 standards. ▪ If the heavy metals characteristics in the compost material do not meet the requirements of FCO standard and MoEFCC 2015 screening levels, the materials shall be sent to KEIL for safe disposal. ▪ If it meets with the requirements, the compost material shall be handed over to the already running compost making unit present in the site with the consent/agreement with the ULB. In this regard, a confirmation letter has been received from the ULB, which is attached in FR..	• Zigma will test fine fractions/legacy biowaste for compliance with FCO standards prior to reuse. • Will improve non-compliant parameters (moisture, EC, nutrients) through biomining and suitable amendments such as compost blending, manure, or additives. • Will ensure heavy metal levels are within FCO 2009 permissible limits before utilization. • Will dispose of non-compliant material at KEIL in accordance with MoEFCC 2015 requirements. • Will hand over compliant compost material to the authorized composting facility with ULB consent.	Contractor/ ULB
14	Leachate	The existing non-functional leachate treatment plant attached	▪ Zigma will prevent discharge of	Corporation

	Treatment Plant (LTP)	with the windrow compost unit results in the discharge of untreated leachate, which may pose a major risk of soil and groundwater contamination, besides creating foul odors and unhygienic conditions for workers and nearby communities. ▪ Before starting the biomining activity, an LTP of required capacity should be established to avoid the contamination of nearby sensitive components due to leachate discharge. ▪ The treated leachate shall be compared with the disposal standards as per the SWM Rule 2016 requirements before disposal. In this regard, after consultation, the ULB issued a letter confirming the utilization of treated leachate by the ULB for landscaping after conforming with the KSPCB requirements. The letter is provided in the FR.	untreated leachate to avoid risks to soil, groundwater, and nearby communities, and will establish and operate a leachate treatment system of adequate capacity prior to commencement of biomining activities. Treated leachate will be monitored to ensure compliance with SWM Rules, 2016 and applicable KSPCB standards, and will be utilized for landscaping in coordination with the ULB, in line with regulatory requirements.	/ Contractor
15	Covered waste heap/mounds and its management	▪ The presence of waste heaps and partially covered mounds leads to dust and odor problems during windy conditions and generates excessive leachate during the rainy season, which may overflow into stormwater drains and cause mosquito breeding, vector nuisance, and community health risks. ▪ To avoid leachate overflow to the nearby areas and mixing up with other fractions or entry into the sensitive receptors, the leachate management plan should cover management of the leachate from the covered waste area. ▪ Separate leachate drains shall be provided and collected in a collection tank before treatment/ recirculation as per the site conditions.	• Zigma will implement measures to control dust, odour, and leachate generation from waste heaps, particularly during windy and rainy conditions, to prevent overflow, vector nuisance, and community health risks. • Will ensure comprehensive leachate management including covered waste areas, with provision of separate leachate and storm water drainage systems, collection tanks, and treatment/recirculation as per site conditions. All handling of waste	Corporation/ Contractor

		▪ To avoid storm water mixing, separate storm water drains should also be ensured at the site. ▪ Handling of all wastes and leachate should be ensured using PPEs, and manual handling of leachate should be avoided. ▪ RDF recovered from the covered waste shall be protected from fire hazards. • All measures for ensuring OHS shall be in place as per the OHS plan prepared by the contractor.	and leachate will be carried out using appropriate PPE, avoiding manual exposure. Zigma will also ensure safe storage of RDF to prevent fire hazards and implement all occupational health and safety measures as per the approved OHS plan.	
16	Accumulated RDF and its management	▪ The accumulated RDF can cause fire incidents leading to toxic smoke and serious health hazards, physical injuries, respiratory issues, and may obstruct biomining operations. To avoid such impacts, ▪ Fire fighting arrangements should be in place in case of fires ▪ Provide PPE and safety training to workers helps prevent injuries and health issues ▪ A fire line shall be provided and maintained. ▪ The first priority should be to remove the RDF with proper agreed forward linkage	• Zigma will ensure timely removal of RDF through approved forward linkages to minimize fire risk. • Will maintain adequate fire prevention and firefighting arrangements. • Will provide appropriate PPE to workers and conduct regular safety training to prevent injuries and health hazards.	Corporation / Contractor

B. Implementation of biomining of the dumpsite

S. No. (1)	Activity/ Probable Impacts (2)	Recommended Mitigation Measures (3)	Contractor's mitigation measures (4)	Responsibility (5)
1	Impact due to the vehicular movement (Air and noise environment & Vehicular - Vehicular & Vehicular - Pedestrian Conflicts)	- Vehicles and machinery are to be maintained so that emission conforms to National Ambient air quality standards. - All vehicles and machinery should obtain Pollution Under Control Certificates - HORN PROHIBITION sign post to be erected. - Rumble strips/speed breaker to be provided on access roads. - Regular maintenance of heavy equipment used at the site and waste hauling vehicles to ensure their exhaust emissions meet the emissions standards prescribed. - Vehicle movement shall be well planned. Ensure surfacing the site access & sprinkling of water to suppress dust before and after the movement of the vehicle - Adopt required measures as per CPCB guidelines, and site & proposed work plan/schedule specific safety requirements. - Avoid heavy vehicle movement through Njeliyanparamba roads during peak hours 7 a.m	- Zigma will ensure all vehicles and machinery are maintained to comply with National Ambient Air Quality Standards and emission norms by monitoring Ambient Air quality fortnightly. - Will ensure all vehicles and equipment possess valid Pollution Under Control (PUC) certificates. - Will install "Horn Prohibited" signage across the site to minimize noise disturbance. - Will provide speed limit (20km/hr) on access roads to regulate vehicle speed and enhance safety. - Will carry out regular maintenance of heavy equipment and transport vehicles to control exhaust emissions. - Will plan and regulate vehicle movement, ensure proper surfacing of access roads, and carry out water sprinkling to control dust. - Will implement all safety and environmental measures as per CPCB guidelines and site-specific work plans. - Will restrict heavy vehicle movement on Njeliyanparamba roads during peak hours (7:00 AM – 10:00 AM, including school hours) and during festivals or important community events. - Will enforce controlled vehicle speed within the dumpsite and ensure all vehicles are equipped with functional reverse horns to prevent accidents.	Contractor, ULB

		to 10 a.m mention: school hrs / peak hrs; and during important period / festivals when people use the road to access temple ▪ Vehicles should move at control speed inside the dumpsite and a reverse horn must be installed in every vehicle to avoid accidents.		
2	Impact due to the use of heavy vehicle and equipment <i>(Air and Noise environment)</i>	▪ Mixing equipment (in case of construction of ancillary facilities) should be well sealed and be equipped with a dust-removal device. ▪ Equipment Operators & labourers should wear dust masks, ear protection, and hard hats. ▪ Vehicles delivering materials should be covered appropriately to reduce spills and dust blowing off the load. ▪ Labor to be provided masks / PPEs. ▪ Construction / Biomining dump site prone to dust generation shall have fencing (of suitable material & height in consultation with communities) to arrest dust spreading into neighboring sensitive land uses ▪ Noise standards at operation machines are to be strictly monitored to prevent exceeding of GOI noise standards. ▪ Strictly adhering to designated working hours (day time); Sensitizing construction truck	• Zigma will carry out regular water sprinkling to control dust emissions. • Will ensure all workers and operators use appropriate PPE including masks, ear protection, and helmets. • Will ensure all material transport vehicles are covered with green net to prevent dust dispersion. • Will monitor and control machinery noise levels to comply with GOI/CPCB standards. • Will restrict operations to daytime hours and ensure switching off of idle engines. • Will deploy well-maintained and regularly serviced vehicles and equipment. • Will enclose or insulate generators and heavy equipment to minimize noise. Will restrict noisy activities between 22:00 and 06:00 considering nearby sensitive receptors.	Contractor

		drivers and equipment operators to switch off idle engines. ▪ Using modern, well-maintained and regularly serviced vehicles. ▪ Ensuring that all generators and heavy-duty equipment be insulated or placed in enclosures to minimize ambient noise levels. ▪ Provision of earmuffs and ear protection to workers and employees in high noise areas. ▪ Workers in the vicinity of loud noise to wear protectors and their working time should be limited as a safety measure. ▪ As Njeliyanparmba dumpsite has sensitive receptors and settlement areas within 200 m of it, noisy works shall be stopped from 22:00 to 06:00. ▪ Machinery and vehicles should be maintained well in good condition to keep their noise to a minimum. ▪ Avoid noisy activities/machines near the west side of the site where settlements exist within 50m. Noise barrier shall be provided at all noise-sensitive locations / for noise generating equipment such as DG sets, mixers (for ancillary facilities) especially near South side of the dumpsite		
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		▪ Adopt required measures as per CPCB guidelines, and site & work specific safety requirements		
3	Impact during the construction activities (<i>water environment</i>)	▪ Labour camps if any (depending on Contractors work plan & arrangements) are to be located away from water bodies. ▪ Vehicle washing or maintenance near water bodies are to be avoided. ▪ Contaminated water from construction / biomining activities carrying soil, cement wash, etc shall not be allowed to flow out of the site. It shall be contained and treated within the site.	• Zigma will ensure labour camps are outside from the biomining site. • Vehicle washing is prohibited at the site and maintenance work will be done at dedicated place (away from the water body). • Will ensure that contaminated water from biomining activities is contained, treated within the site.	Contractor
4	Leachate and Runoff from biomining activities (<i>Soil contamination and groundwater contamination</i>)	▪ Provide site cut off drain around the site to divert off stormwater from entering the site, and to prevent contaminating downstream resources with run off from the dumpsite ▪ Depending on the contractors plan for biomining of the covered area on site, implement leachate management to cause no harm to communities & environment ▪ Ensure stormwater drains will lead to drain outlets (along the south east boundary of the site) on roads adjoining the dump yard ▪ Provide leachate drains lined from probable leachate pool areas (based on site geography or slope) and carry it to the leachate treatment area preferably to the South East corner of the site.	• Zigma will maintain the existing drains and, wherever required, provide additional trenches connected to existing drainage lines for effective flow management. • Will provide cut-off drains around the site to prevent stormwater ingress and avoid contamination of downstream areas. • Will implement a comprehensive leachate management system based on the biomining plan to prevent impacts on communities and the environment. • Will ensure stormwater drains are directed towards designated outlets along the south-east boundary of the site. • Will provide lined leachate drains from potential leachate accumulation areas and channelize it to the treatment area, preferably at the south-east corner.	Contractor

		▪ Provide proper treatment of leachate and stormwater that unavoidably flows through dump or wastes in a tank, constructed wetland in the site or other such arrangements. Treated water/leachate shall be stored for reuse in greenery or for wash purposes (Initiate green belt development on-site parts which will not be impacted by biomining activities like excavation and waste segregation and stabilization ▪ The quality parameters for recycling and reuse applications must be as per SWM Rules, 2016 or other applicable standards. The treated water quality needs to be tested at prescribed regular intervals – once a week. The treated leachate water quality needs to comply with the latest standards prescribed by the KSPCB/CPCB. ▪ The storage areas of the facility should have a leachate barrier system that forms a secure barrier between the groundwater, soil, and substrata ▪ Design and maintain the slope and orientation of leachate drains such that free drainage of leachate to a collection drain is facilitated and ponding of leachate is avoided; shape the piles and windrows to maximize runoff	• Will treat leachate and contaminated stormwater through appropriate systems (tanks, wetlands, or equivalent) and reuse treated water for greenbelt development and site purposes. • Will ensure treated water quality complies with SWM Rules, 2016 and applicable CPCB/KSPCB standards, with regular monitoring (weekly). • Will provide leachate barrier systems in storage areas to prevent contamination of soil and groundwater. • Will design and maintain slopes and drainage systems to ensure free flow of leachate and prevent ponding. • Will provide channels around waste windrows and ensure proper collection and recirculation/treatment of leachate. • Will plan major biomining activities during non-rainy periods and minimize exposed waste during monsoon. • Will store leachate in above-ground tanks and ensure emergency containment to manage flooding or overflow risks. • Will assess and strengthen retaining structures and develop vegetation barriers along site boundaries to prevent leachate outflow. • Will install and operate a leachate treatment plant of adequate capacity for biomining operations.	
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		and hence reduce infiltration ▪ Provide channels to collect leachate around heaped waste windrows (for air contact or enhancing natural drying) and provide cut off drain around all work areas with collection facility for leachate at the lower gradient and channelizing to the leachate treatment or recirculation mechanism ▪ Plan the works on-site only during non-rainy seasons and to complete the works before rains ▪ Store leachate preferably in above ground storage tanks or such arrangements to minimize contamination and impacts of submergence/flooding/rains, and provide for emergency containment additionally. ▪ An assessment of the strength and alignment of the retaining wall on the southern side will be conducted for mitigation. Additionally, a line of vegetation or plantation will be established along the southern perimeter inside the compound to prevent the outflow of leachate. ▪ The biomining contractor shall install a leachate treatment plant to treat leachate generated during the biomining. The liquid discharge from the existing compost plant of the		
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		ULB shall be effectively contained to prevent its flow into the biomining project site. For this purpose, appropriate physical barriers shall be provided, which may include the construction of a single row brick wall with a minimum height of 100 mm		
5	Excavation of waste from the waste mound <i>(Health and safety impacts)</i>	▪ The contractor will ensure that waste excavation is conducted in a manner that does not greatly disturb the matrix of the existing waste mound. ▪ Care should be maintained, especially when working on the slopes to ensure further failures do not occur due to the height of the mound. Slips of waste / stored heap and worker shall be avoided ▪ Machinery operated for excavation should be operated by skilled operators at all times. ▪ Workers working on machinery and site during excavation should be geared with full-body suits preferably of fluorescent color, masks helmets, boots and gloves, and heat protection equipment to avoid exposure with raw decomposing waste material, which can be at higher temperatures. Proper harness and toes shall be used considering slipping possibility on	• Zigma will carry out excavation with no/minimal disturbance to the existing waste matrix. • Will maintain slope stability and prevent slips of waste and personnel during operations. • Will ensure excavation machinery is operated only by skilled and trained operators. • Will ensure use of full PPE including fluorescent suits, masks, helmets, gloves, boots, heat protection. • Will execute excavation in a planned and sequenced manner to avoid uncontrolled exposure of waste. • Zigma acknowledges that provision of engineered retention structures may not be practically feasible due to continuous movement of heavy machinery; however, unstable edges will be identified, access will be restricted through regular TBT (Toolbox Talks), and appropriate barricading/signage will be provided to prevent entry. Will ensure excavated waste is covered and managed with garland drains for proper leachate collection and treatment.	Contractor

		wastes. ▪ Excavation work shall be carried out in a sequenced manner, to avoid ad-hoc exposed areas on the waste mound ▪ In case of the waste mound and site edges are sliding or unsafe; provide engineered retention walls or string boundaries. ▪ When stockpiled, wastes mined out should be covered and with garland drain to collect leachate and channelize it to the leachate collection & treatment mechanism.		
6	Removal and processing of legacy biowaste from the windrow shed	▪ During the removal and processing of legacy biowaste kept inside the windrow shed, there could be possible impacts on the ongoing window compost activity and the workers associated with it. So the contractor should implement the following, ▪ Segregate the work zones using physical barriers to prevent cross-contamination between the windrow compost area and the legacy biowaste removal site. ▪ Schedule removal activities during non-operational hours of the windrow or as per the agreement with them to minimize disruption and exposure.	• Zigma will schedule removal activities in coordination with windrow operations to minimize disruption and exposure. • Will implement dust and odour control measures including water sprinkling and covering of waste during transport. • Will ensure all workers are provided with appropriate PPE including gloves, masks, and safety boots. Will collect and treat leachate using lined containment systems and channelize it to the treatment facility to prevent contamination.	Contractor

		▪ Use dust suppression methods like water spraying and cover the waste during transport to control odor and airborne particles. ▪ Provide PPE such as gloves, masks, and safety boots to all workers involved in the removal process. ▪ Collect and treat leachate from the legacy biowaste using lined containment systems and direct it to the leachate treatment facility to prevent soil and groundwater contamination.		
7	Transportation of wastes or retrieved or other material in overloaded and open vehicles <i>(Air, Odour nuisances; spills and littering impacts on Air, Water, Land)</i>	▪ All vehicles shall carry only approved load of weight ▪ Regular cleaning of roads & drains and removal of spills if any. ▪ All waste transport vehicles shall be covered and movement shall be during non-peak hours. ▪ Ensure provisions of SWM Rules 2016 & other relevant rules such as Biomedical Waste Management Rules or Hazardous Waste Management Rules 2016 or others as applicable for all waste / retrieved material Transportation activities. ▪ Adopt required measures as per CPCB guidelines, and site specific safety requirements.	• Zigma will ensure all vehicles carry only approved load limits. • Will carry out regular housekeeping promptly remove any spills. • Will ensure all waste transport vehicles are covered and operated during non-peak hours. • Will comply with SWM Rules, 2016 and other applicable waste management regulations for all transportation activities. Will implement all CPCB guidelines and site-specific safety requirements.	Contractor
8	Soil contamination assessment	▪ As part of the Feasibility Study, the tested parameters were well within the screening levels of the MoEFCC 2015 for industrial requirements.	• Zigma will ensure that soil parameters comply with MoEFCC 2015 screening levels and monitor key parameters during biomining.	

		Copper showed relatively higher values in all samples, however well within the screening levels. - As part of soil utilization during biomining, the project and ULB shall ensure through continuous monitoring that such soil remains confined to the site and is not used for agricultural or any other purposes, but strictly for backfilling within the site. - During biomining, the soil must be tested to confirm the absence of contamination; if contamination is detected during or after the completion, it must not be spread and should be securely heaped with restricted access. The ULB shall plan for full appropriate remediation or disposal through capacitated/qualified agencies, which is outside the scope of KSWMP.	- Will ensure that processed soil is confined within the site and used only for backfilling, in coordination with the ULB. - Will conduct regular soil testing during biomining and restrict use of any contaminated soil. Will ensure contaminated soil, if identified, is securely stored with restricted access and reported to the ULB for further remediation or disposal.	ULB
9	Occupational health and safety impacts of the workers during the biomining & construction of support facilities: Health impacts of exposure to a	- Avoid direct & double handling of wastes through avoidance measures (suitable planning & equipments), engineering controls & use PPEs - Work area & Labour camps shall be provided with First Aid and other related activities. - Emergency Preparedness plans shall be	- Zigma will minimize waste handling through proper planning, engineering controls, and use of PPE. - Will provide first aid, welfare facilities (rest areas, toilets, drinking water), and maintain hygienic conditions at site and labour camps. - Will prepare and implement Emergency Response Plans, EHS Policy, and site-specific SOP's. - Will deploy adequate manpower, ensure grievance redressal, and comply with all labour laws including worker registration and insurance.	

	variety of harmful materials of waste related pollutants. • Accidental Spillage of chemicals/other materials, biocultures or wastes etc; by moving vehicles. • Cut & Bruises during handling of materials/Rejects • Allergies from pathogen and airborne dust <i>(Air environment, Health impacts)</i>	prepared and implemented for all manpower working centers and its field extension centers. ▪ An Environment Health & Safety policy shall be prepared and implemented ▪ Adequate manpower shall be provided & manager & staff shall listen and act upon the manpower related grievances. ▪ Workers will be provided with PPE such as face mask, gloves, shoes, nose masks & goggles ▪ Provide / cull out non-slippery work areas as much is feasible; or provide with safe strong holding bars, harness, strings any other appropriate safety equipment to ensure that the activities are performed without slip, trip, fall especially on waste, leachate or trenches ▪ Proper training will be provided regarding the maintenance of health ▪ Workers shall be provided with scrubbing facilities / wash areas; rest areas, toilet facilities (may be mobile toilets with septic tanks & water supply), food, and water in a hygienic environment (with proper handwash). Provide clean eating areas where workers are not exposed to contaminated,	▪ Will provide mandatory PPE (masks, gloves, shoes, goggles, helmets) and ensure use of high-visibility Safety jacket. ▪ Will ensure safe working conditions including non-slippery surfaces, fall protection systems, and safe access in high-risk areas. ▪ Will conduct regular training, toolbox talks, hazard assessments, and safety briefings for all new joiners, employees, workers and visitors. ▪ Will ensure proper housekeeping, routine inspections, and maintenance of site, equipment, and vehicles. ▪ Will establish tie-ups with nearby health facilities and ensure emergency medical support including ambulance and health check-ups. ▪ Will identify and secure the site hotspots from unauthorized access and ensure proper signage, lighting, and hazard marking as per standards. ▪ Will ensure safe operation of machinery with alarms, flagmen, traffic control measures, and restricted access to operating zones. ▪ Will implement electrical safety measures including proper insulation, earthing, and avoidance of overloading. ▪ Will implement work permit systems for high-risk activities such as working at height and hot work. ▪ Will prohibit entry of intoxicated workers and ensure supervision of all critical activities including excavation. ▪ Will maintain all records related to safety, incidents, Mock drills, training, and operations, and report serious	Contractor, ULB
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		hazardous or noxious substances. ▪ First aid facilities will be available at accessible places. More than one first aid station if the site is large or work schedule requires thus ▪ Tie-up with the local hospital / Family, Primary or Community Health Centre and ASHA worker to be arranged through responsible Health Inspector of ULB or HC to be arranged to provide an ambulance to handle emergency cases and for regular health checkups. Arrange daily health checkup for workers working on waste heaps ▪ Routine inspections, housekeeping, and maintenance of vehicles, site to be carried out at regular intervals. ▪ Measures such as deferred timings and stretch break to be adopted ▪ Secure all installations from unauthorized intrusion and accident risks; ▪ Undertake hazard assessment & prepare site and activity specific mitigation plan at the start of any subproject activity. Also undertake hazard assessment, safety briefing & tool box talks during every day start of works / activities. Key hazards would be (but not limited to) are	incidents as per applicable requirements including Bank protocols.	
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		flammability, work on ground which may be soggy & have leachate pools, fire hazards, gas and heavy machines & equipments, slips of men & material (retrieved) stacked, biohazards, explosion of existing batteries/other materials, infections, infectious/hazardous wastes etc. ▪ EHS specialist with adequate experience & third party supervision are important for biomining activity ▪ Provide H and 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 injury to fellow workers. Safety flashes may be prepared for exchange with new works (migrants) or other sites ▪ Provide visitor orientation if visitors to the site need to gain access to areas where hazardous conditions or substances or stored materials may be present. Ensure also that visitor/s do not enter such areas unescorted. Communities esp. school children shall be advised to avoid work/vehicle movement areas as much possible		
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		▪ Ensure the visibility of workers through their use of high visibility vests when working in or walking through heavy equipment operating areas; ▪ Ensure moving equipment is outfitted with audible back -up alarms & flag men with whistles or speakers; ▪ Electrical wires should be properly insulated and earthed, no exposed wires and no overloading thus it will reduce the accidents due to electrical short circuit. ▪ Mark and provide signboards for hazardous areas such as energized electrical devices and lines, service rooms housing high voltage equipment, and areas for storage and disposal. Signage shall follow international standards and be well known to, and easily understood by workers, visitors, and the general public as appropriate. Any electric wires, or appurtenance to be marked well & safe kept before activity start near those. In close proximity to this location, there is a transformer. Disallow worker exposure to noise level greater than 85 dBA for more than 8 hours a day without hearing protection		
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		▪ All workers shall be registered as per prevalent labor laws (including a workforce of subcontractors) and provided insurance cover & others as per existing acts/laws ▪ Workers and their kith and kin shall be suitably informed about the registration, other details of workers, and insurance details and provide contact details of contractors person/insurance agent ▪ While using heavy machinery like JCB, cranes, etc, inform workers on possible dangers and prevent going near operating / movement areas. Flagmen should be arranged on-site with a whistle. ▪ While using heavy machinery like JCB, cranes, etc, inform communities to prevent children and others from going near operating / movement areas including roads. ▪ Flagmen shall be arranged if work is near schools, hospitals, major roads, and traffic control is required with the support of police. Traffic management plan to be prepared, got approved & followed as required. Communities esp. school children to be advised to use alternate roads if possible		
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		▪ A work permit system will be implemented for all works related to working at heights (typically when working over 2m and above – for example in case of any activity on heaped wastes) and for hot jobs; ▪ No worker shall enter site in intoxicated condition & suitable checks shall be adopted by the contractor ▪ All works related to working at heights will be undertaken only during the ▪ daytime when sufficient sunlight is available; ▪ Use of temporary fall protection measures and outer edges of any elevated work surfaces, such as handrails and toe boards to prevent materials from being dislodged will be done; ▪ All excavation activities to be conducted in supervision of the site contractor; ▪ Proper signage and lights to be provided in all work or activity areas & work permit system to be ensured. ▪ All records on emergencies, accidents, workers & their duty schedule, important site events, waste storage & disposal etc shall be maintained on site. All accidents including Indicative, Serious and Severe accidents to be		
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		recorded. All severe & serious accidents to be reported to the Bank & procedures followed for root cause analysis & Corrective Action Plans ▪ prepared and implemented, as per Banks Incident Reporting Tool		
10	Risk of fire due to conditions leading to spontaneous combustion <i>(Air environment, disturbance to communities and workers, health impacts, safety issues)</i>	▪ Follow CPCB Directions (May 26, 2022) Directions under Section 5 of EP Act (1986) – for Implementation of SWM Rules 2016 – regdg Fire Incidents at MSW Dumpsites (https://cpcb.nic.in/openpdf.php?id=UHVibGljYXRpb25GaWxlZQyNDRfMTY1NDE2Mzk3N19tZWRpYXBob3RvNzYxMi5wZGY=), LSGD Kerala Government GO on Fire Safety of, MCF cum RRFs (for the MRF on site if used for storage of wastes) and other Regulations, guidelines applicable ▪ Divide the site & plan for work in each area/quadrant as per work plan & prepare fire safety plan & emergency response plan in line with EIA Annexure 3 of FR; and National/State regulations & WB EHS ▪ Examine the site everyday by experienced Fire Safety / OHS personnel for any smokes ▪ Avoid conditions that can lead to spontaneous	▪ Zigma will comply with CPCB directions, SWM Rules 2016, Kerala Government fire safety guidelines, and all applicable regulations. ▪ Will conduct daily inspection of the site by trained EHS personnel to identify fire risks. ▪ Will prohibit smoking and any activity that may lead to fire or spontaneous combustion. ▪ Will ensure site layout allows access for firefighting equipment and availability of adequate water supply. ▪ Will train all workers on fire hazards, prevention, and emergency response measures. ▪ Will restrict unauthorized entry. ▪ Will provide and maintain adequate firefighting equipment. ▪ Will store fuels and flammable material safely in ventilated, bunded areas away from operational zones and spill kits will be used for emergency spillage. ▪ We are currently in the process of obtaining the Fire NOC, and all applicable recommendations will be complied with accordingly.	Contractor, ULB

		combustion such as: ▪ Smoking Ban: Prohibit smoking in all areas of the dumpsite facility to eliminate a common fire hazard ▪ Preventing Fires: Strictly forbid activities like intentionally setting fire to materials in the dumpsite. ▪ Design the facility for access by firefighting equipment, including clear aisles among waste heaps or work areas and access to adequate water supply. ▪ Ensure workers are briefed of fire hazard & its management ▪ No unauthorized entry shall be permitted to the site; including of workers during holidays, night time, or hours other than normal work hours under the supervision of site engineer / supervisor. Fencing and barricades with proper signage boards indicating “trespassers not allowed” ▪ The following activities should be implemented to prevent fires from occurring at the facility ▪ adequate fire-fighting equipment should be made available on-site and stored in an accessible manner, all operating staff should be	▪ As per CPCB/NGT directions on dumpsite fire safety will conduct quarterly fire mock drills and maintain emergency readiness. ▪ Will promptly contain any fire/smoke within the site and seek fire brigade support when required. ▪ Will display emergency contact details and ensure workers are trained for emergency response.	
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		trained and able to manage fire outbreaks at any part of the facility. ▪ clear signage should be established to inform workers and the public that flammable liquids are not permitted on the site. This should be reinforced by advice to customers at the gatehouse and inspection of loads at the organic reception area. ▪ Approved quantities of combustible contaminants that have been separated (such as tires and plastic bottles) should be stockpiled in small piles or windrows. ▪ All fuels or flammable solvents for operational use should be stored in an appropriately ventilated and secure store (at appropriate height). This store should be located away from the biomining, storage, and processing areas. ▪ All flammable liquids should be stored within a bund that can hold 110% of the volume of the flammable liquids stored there so that any release of raw or burning fuel cannot cause a fire in the combustible organics present on the site or have an impact on contaminating storm water. ▪ The local fire brigade shall be informed of the		
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		activity, and fire safety plan shall be submitted for their comments/feedback & implemented throughout the biomining activity in line with National State regulations, guidelines and international good practices ▪ A fire rescue station exists at the site. Ensure that appropriate fire safety standards, facilities, equipment are in place for storage and transportation stages. Fire mock drills to be conducted monthly once. ▪ Contain all local smokes/small fires inside the dump asap. Fire brigade help shall sought on all smokes/fires outside the dump asap ▪ Ash from fires to be contained at the earliest within the site using bunds or screens, rather than allowing to disturb nearby receptors. Early clearing and disposal of such ash at TSDF to be ensured. ▪ Provide contact details of Fire Department & ambulance other essential emergency services on site & ensure training to the workers by such service providers		
11	Construction of new facilities in retrieved land	▪ The excavated site shall be protected from any dumping during or after the biomining activity and shall be reserved for SWM activities in	Not Applicable for Zigma after handover of cleaned dumpsite site to ULB.	

		line with SWM Rules 2016 Any new facility under KSWMP to be constructed on the retrieved land, shall follow EMF procedures & National State regulations		ULB
12	Pest / Vermin Control & Visual impacts (Odour, flies, rodent / other pest menaces)	- Regular cleaning and approved pest control measures to be adopted; preferably in coordination with Health section of ULB & local Health Center - Communities around shall be made aware of possible pest menace & ULB shall support those in need with required pest management measures and offered health checkups - Biopesticides / biological control shall be followed. However, biopesticides, or bio cultures used shall be tested to ensure the presence of no banned chemicals or hazardous materials - Banned pesticides/insecticides shall not be used. - Workers shall be made aware of storage and use of pest control measures and PPEs to be used - Visual blight to be curtailed by screens, proper lighting, housekeeping, leachate management	- Zigma will implement regular housekeeping and approved pest control measures in coordination with the ULB and local health authorities. - Will support community awareness on pest management in coordination with ULB and facilitate necessary health measures. - Will use only approved biopesticides/biological controls and ensure no banned or hazardous substances are used. - Will train workers on safe handling, storage, and use of pest control measures and PPE. Will control visual impacts through proper screening, lighting, housekeeping, and effective leachate management.	Contractor, ULB
13	Odour nuisance	- Waste with a strong odor to be covered immediately they are emptied from vehicles. - Control and manage leachate treatment to minimize odor.	- Zigma will ensure immediate covering / control of odorous waste upon unloading to control odor emissions. - Will manage leachate treatment effectively to minimize odor generation.	Contractor,

		▪ Provide buffers screens to curtail odor from reaching surrounding communities especially to North side of site. ▪ Using natural deodorizers such as lemongrass, eucalyptus etc. and planting fragrant flowering plants around the site to mask odor.	▪ Will install screens to prevent odor dispersion, especially towards the north side of the site. ▪ Will use natural deodorizers and develop plantation with fragrant species to mitigate odor.	ULB
14	Storage, Collection, Transport, Treatment & Disposal of wastes and rejects	▪ Storage, Collection, Treatment, treatment & disposal mechanisms for retrieved wastes & rejects/inerts in line with applicable regulations for each type of waste. ▪ Adequate covering is necessary for the waste or stored fractions. Inerts shall be stored in RRF area. Storage, Collection, Transport, treatment or disposal of retrieved legacy wastes or rejects/inerts shall not be in a manner that disturbs any sensitive receptor or area (communities, waterbodies, air, soil, biodiversity etc); & adequate protection shall be made to prevent such impacts even during rains / disasters ▪ Waste handling shall be inline with existing regulations & guidelines & avoid health & safety impacts ▪ No material is allowed to remain on site after the contract period ▪ Adequate fire safety arrangements &	• Zigma will ensure storage, collection, transport, treatment, and disposal of all retrieved waste and inert in compliance with applicable regulations. • Will ensure proper covering and safe storage of waste (including inert in designated RRF areas) without impacting nearby communities during rainy season. • Will handle all waste in line with regulatory guidelines to avoid health and safety risks. • Will ensure no material remains on site after completion of the contract period. • Will implement fire safety measures and provide training to workers in coordination with the local fire brigade. • Will coordinate with ULB to ensure GPS-based tracking of vehicles for disposal at designated locations. Will implement necessary safety and environmental measures during transportation, considering shared public access roads.	Contractor, ULB

		awareness & training to workers shall be ensured on site & at disposal / treatment areas for wastes in discussion with Local Fire Brigade to prevent any fire on legacy waste site or retrieved & stored wastes or that is transported ▪ Vehicles movement shall be tracked by ULB to ensure disposal of material/rejects/inerts in designated or agreed area & are in line with schedule; using GPS. ▪ Given that the access road is used by the public, it is imperative to ▪ Implement the required safety precautions and environmental protection measures when transporting the waste.		
15	Other activities	▪ The existing RRF and Windrow compost facilities are functional. Hence, care should be taken by the contractor not to affect the functioning of these facilities. ▪ Appropriate measures shall be implemented to enclose the RRF and Windrow areas and their operations using fencing or protective barriers. ▪ A feasible traffic management plan should be prepared by the contractor without affecting biomining activities and the RRF & Windrow facility activities.	▪ Zigma will ensure that biomining activities do not disrupt the functioning of existing RRF and windrow compost facilities. ▪ Will demark our area separately from RRF and windrow operational areas. ▪ Will ensure safe vehicle movement for smooth operations of biomining, RRF, and windrow facilities.	

16	Energy Efficiency & Water Use efficiency	▪ All activities to consider energy efficient & clean fuels; and use of energy efficient equipment & biomining / construction techniques ▪ Landscaping & green belts to use local / indigenous plants & trees ▪ Waste water and Leachate to be treated & recycled/reused	▪ Zigma will implement energy efficiency measures by optimizing equipment usage, avoiding idling of machinery, ensuring timely shutdown of idle equipment, and switching off lighting when not required. ▪ Will develop landscaping and green belts using local and indigenous plant species wherever feasible, considering the operational constraints of the biomining site. ▪ The wastewater shall be reused / recirculated / treated.	Contractor
17	Cumulative impacts due to the operations of BPCL's Bio-CNG & Windrow composting by M/s Blackfly technologies and Bioming	▪ The simultaneous commencement of BPCL's Bio-CNG plant construction and Blackfly's ongoing windrow composting activities in the recovered area will result in overlapping of operations within the site, leading to cumulative dust, odor, and leachate load, increased machinery noise, congestion of space, and heightened safety risks for both workers and the surrounding public. ▪ These concurrent activities may also trigger public inconvenience, complaints, and additional mitigation costs, even though they could generate some additional local employment. ▪ Measures shall be taken by the contractor with the support of the ULB to prioritise the works not hinder the functioning of the existing or associated facilities. ▪ While removing the wastes from the designated site of the BPCL BioCNG plant, a buffer	▪ Zigma will coordinate with ULB and stakeholders to ensure biomining activities do not hinder ongoing or proposed facilities and manage cumulative impacts such as dust, odour, noise, and safety risks. ▪ Will ensure clear segregation of areas and prevent dumping of fresh waste or rejects into the legacy waste/biomining area. ▪ Zigma will plan and execute operations to minimize public inconvenience and address complaints in coordination with ULB. ▪ Where applicable & feasible, will maintain required greenbelt development in consultation with ULB. ▪ Zigma will redirect the leachate into LMP to prevent leachate movement into adjacent facilities. ▪ Will ensure that biomined or segregated waste is not stored in operational or access areas of nearby facilities.	Contractor

		shall be provided for the green-belt provisions of the BioCNG plant on a mutual consensus by the ULB. ▪ To avoid leachate movement from the biomining site to the nearby facilities, a separation should be constructed, which may include the construction of a single row brick wall with a minimum height of 100 mm. ▪ Biomined or segregated waste should not be kept on the premises or the vehicle paths of the nearby facilities. ▪ All vehicle paths should be free of hindrances and protected with barricades and a safety personnel should be engaged during all operations.	▪ Zigma will demarcate the vehicle movement path for smooth traffic circulation within the site along with the speed limit and deploy safety personnel to manage operations.	
18	Full-time supervision for Environmental and OHS Requirements	▪ An Environmental and OHS Specialist should be appointed to monitor and ensure compliance with all environmental safeguards throughout the project duration including monsoon period.	Zigma will appoint a qualified Environmental and OHS Specialist to monitor and ensure compliance with all environmental and safety requirements throughout the project duration, including the monsoon period..	Contractor
19	Daily Environmental Monitoring and its reporting in KoboToolbox	▪ As part of ensuring the EMP and OHS compliance as per the EMP, daily monitoring should be conducted and the results to be updated in the Kobo Toolbox application for daily evaluation.	Zigma will conduct daily monitoring to ensure EMP and OHS compliance and update the results in the Kobo Toolbox application for regular evaluation.	Contractor
20	Peripheral Greenbelt	▪ Establish a green belt using indigenous three layers of herbs (flowering and fragrant), shrubs, and trees.	Zigma will establish a green belt using indigenous species in three layers comprising herbs (flowering/fragrant), shrubs,	Contractor

			and trees, wherever feasible within the site., in consultation with KSWMP.	
21	Accumulated RDF and Fire Risk	The accumulated Refused Derived Fuel (RDF) on-site poses significant fire hazards, which may cause: ▪ Toxic smoke generation and serious health hazards to workers and nearby communities ▪ Physical injuries and respiratory issues to on-site personnel ▪ Environmental pollution due to uncontrolled combustion of waste materials ▪ Risk of fire spread to adjacent areas including nearby residential zones within 200m	▪ RDF Disposal & Storage Control: RDF shall be disposed on a daily basis through established forward linkages (cement plants), minimizing on-site storage. RDF handling shall be confined to designated areas with proper demarcation and safe clearances. ▪ Fire Prevention Measures: Strict housekeeping shall be maintained and ignition sources (smoking, open flames) shall be prohibited in RDF areas. Site shall be secured with fencing and controlled access; dedicated security guard shall be deployed for monitoring and prevention of fire risks. ▪ Fire Detection & Monitoring: Continuous monitoring of RDF areas shall be ensured by site personnel and security staff. Basic alert/communication mechanism shall be maintained for emergency response. ▪ Firefighting Resources: Fire management arrangements at site shall include water tank of more than 50,000L, pumps (180LPM jockey electrical pump & 1100 LPM portable Honda pump), hose reels (200 meters), and excavators with soil for immediate response. Fire buckets and fire extinguishers shall be deployed at all RDF handling and storage locations. ▪ Emergency Preparedness: Emergency contact numbers (Fire, Police, Ambulance, Site In-charge) shall be prominently displayed at site. Tie-up with the nearest fire station shall be established for handling major fire incidents.	Contractor

			▪ Training & Awareness: Site personnel shall be briefed on basic fire safety practices and emergency response procedures. ▪ Monitoring & Reporting: Regular monitoring of RDF handling and fire safety arrangements shall be carried out, and any incidents shall be reported to the concerned authorities as per requirement.	
22	Snake Presence (Reptile) and Associated Safety Risk	Snake Presence (Reptile) and Associated Safety Risk	• Habitat Control & Site Management: Vegetation, shrubs, and debris shall be regularly cleared to prevent snake habitation. Waste, scrap, and unused materials shall not be allowed to accumulate on site. Work areas, pathways, and storage zones shall be kept clean and well-maintained. • Monitoring & Inspection: Regular site inspections shall be conducted to identify snake-prone areas. Any snake sighting shall be immediately reported to site management. • Emergency Response Measures: Tie-up with local forest department / authorized snake rescue agency shall be established for safe handling and relocation. Emergency contact numbers (Forest Department, Snake Rescuers, Hospital, Site In-charge) shall be prominently displayed. Basic first-aid provisions for snakebite shall be available at site. • Training & Awareness: Workers shall be sensitized on snake awareness, do's & don'ts, and emergency response procedures. Use of PPE such as safety shoes and gloves shall be ensured, especially in high-risk areas. • Monitoring & Reporting: All snake sightings/incidents shall be recorded and reported to the concerned authorities as required. Periodic review of site conditions shall be carried out to minimize recurrence.	Contractor

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C. Site-Specific Sensitivities, Impacts and Mitigation Measures for Biomining Activity

Site Specific Sensitivities	Impacts	Recommended Mitigation Measures	Contractor's Mitigation Measures	Responsibility
River / Stream Conolly Canal (man-made canal joining Chaliyar & Kallai rivers): ~350-500 m (East) Chaliyar River (nearest reach at Feroke/ Cheruvannur): ~1,700 m (South)	Leachate runoff contaminating surface water; increased turbidity; odour nuisance; disturbance to aquatic ecology	Maintain buffer zone as per SPCB norms; no discharge of untreated leachate; provision of garland drains and leachate collection tanks; impermeable flooring; regular surface water quality monitoring; compliance with SWM Rules, 2016 and CPCB biomining guidelines.	Leachate Management system will be installed at the leachate prone areas. No direct discharge to nearby water bodies. Biweekly surface water quality monitoring will be carried out.	Contractor
Residential Areas, Schools/Colleges and Religious Centres Kolathara Residential Area: ~300-400 m (NE) Nallalam Modern Bazar: ~700 m (NW) Calicut Orphanage High	Odour nuisance affecting nearby population; dust emissions causing health impacts, especially to children and elderly; noise disturbance; safety risks from vehicular	Maintain adequate buffer distance; scheduling of noisy activities outside school hours and prayer times; water sprinkling for dust suppression; odour control measures; restricted daytime operations; covered transportation; traffic management	Noise-generating activities will be strictly followed as per CPCB standards; water tanker sprinkling on haul roads twice daily; covered/tarpaulin-covered waste transport vehicles; air quality and noise monitoring at nearest residential receptor (Kolathara, ~300 m);	Contractor

Site Specific Sensitivities	Impacts	Recommended Mitigation Measures	Contractor's Mitigation Measures	Responsibility
School & LPS, CICS TTI: ~450-470 m (NW) Salafi Masjid (Nallalam): ~400-450 m (NW) Rahiman Bazar Juma Masjid: ~830 m (NE) Kolathara North Juma Masjid: ~940 m (E)	movement; inconvenience and public opposition	and safety signage; regular air quality and noise monitoring; community consultation and grievance redressal mechanism	complaint/grievance register maintained and reviewed monthly;	
Agricultural Land Peri-urban paddy fields & mixed agriculture (Kolathara / Cheruvannur fringe): ~500 m – 1.5 km (various directions)	Soil contamination due to improper handling of waste; reduced crop yield; dust deposition on crops	No waste stockpiling near agricultural fields; biomining activities only on lined working surface; regular soil quality monitoring; dust suppression measures and wind barriers	Within 1.5 KM radius (aerial distance) from the centre of the dumpsite, there is no presence of agricultural farm land.	Contractor
Groundwater Sources (Wells / Borewells) Residential wells in Kolathara & Nallalam localities: ~200-500 m (NE/NW) Site operational borewell	Groundwater contamination due to leachate percolation; associated public health risks	Impermeable base for biomining operations; effective leachate collection and treatment system; periodic groundwater quality monitoring; compliance with IS:10500 drinking water quality standards	Groundwater monitoring shall be carried out biweekly. As per IS:10500 drinking water quality will be maintained. In case of contamination, compliant potable water will be provided to affect neighbouring households.	Contractor

Site Specific Sensitivities	Impacts	Recommended Mitigation Measures	Contractor's Mitigation Measures	Responsibility
(proposed by BPCL/operators): Within site boundary				
RDF Accumulation and Fire Risk RDF storage area within site compound — potential ignition hazard to surrounding residential localities within 300-800 m radius	Accumulation of combustible RDF leading to fire outbreaks; release of toxic smoke and fugitive emissions; risk to workers and nearby population; secondary pollution of air, soil and water due to fire-fighting runoff	Avoid long-term storage of RDF; maintain stack height and quantity limits as per CPCB guidelines; provision of fire detection and fire-fighting systems; maintain safe distance between RDF stacks; emergency preparedness and fire management plan; prohibition of ignition sources; regular inspection and moisture monitoring of RDF	The plan is to dispose RDF on a daily basis and not to store as heaps. However RDF dispatch will start after a few weeks from the commercial run, during which RDF will be stored as heap, not exceeding 4 m height and 20 m width. Fire safety measures including water tank of more than 50,000L, excavators with soil, pumps (180LPM jockey electrical pump & 1100 LPM portable Honda pump), hose reels (200 meters), and security deployment shall be ensured. Fire extinguishers and sand buckets shall be available, with no open flames within 30 m and tie-up with the nearest fire station shall be in place for major incidents. Emergency contact details shall be prominently displayed.	Contractor

Conclusion

This Environmental Management Plan (EMP) establishes a structured framework to manage and mitigate environmental and social impacts during Commissioning, Operation, and Dismantling stages. The Plan aligns with applicable national regulations including the Solid Waste Management Rules, 2016, and integrates with Zigma's Corporate ESMS framework to ensure systematic monitoring, compliance, and continuous improvement. Periodic review and updating of this EMP shall be undertaken to incorporate regulatory changes, monitoring outcomes, and operational learnings, thereby supporting sustainable project implementation.

This EMP ensures that project activities are undertaken in an environmentally responsible, socially accountable, and legally compliant manner. Periodic review and updating of this EMP shall be undertaken to incorporate regulatory changes, monitoring outcomes, and operational learnings, thereby supporting sustainable project implementation.