

**ETHIOPIA PUBLIC HEALTH INSTITUTE
FEDERAL DEMOCRATIC REPUBLIC OF ETHIOPIA
MINISTRY OF HEALTH MINISTRY OF HEALTH**

**ENVIRONMENTAL AND SOCIAL IMPACT
ASSESSMENT**

Executive Summary

August 2019

Africa CDC Regional Investment Financing Program (P167916)

EXECUTIVE SUMMARY

Introduction

Though Ethiopia has made tangible progress to improve health care system for the provision of quality services, there are several gaps and challenges which are not addressed as well. Most of the laboratories in the health care system including the National Reference Laboratories function in facilities with sub-optimum infrastructures, poor safety working environment, shortage of equipment, supplies interruption and huge gaps in the implementation of Laboratory Quality Management System. The overall desire of the Government of Ethiopia is to have the highest possible level of health and quality of life for all its citizens, attained through providing and regulating a comprehensive package of promotive, preventive, curative and rehabilitative health services of the highest possible quality in an equitable manner. To tackle these problems, the government of Ethiopia plans to construct Biosafety Level Three (BSL3) National Reference Laboratory and associated facilities at Ethiopian Public Health Institute (EPHI). The EPHI Strategic Plan Management (2015/16 to 2019/20) and the Ethiopian Action Plan for Health Security (2018-2022) foresee the construction and equipping of the proposed BSL-3 National Reference Laboratory complex with the objective to elevate the capacity and status of the institute to conduct specialized testing, with a focus on the diagnosis of emerging and re-emerging lethal pathogens.

Conventional EIA methodological approaches were applied for carrying the assessment which includes the following: desk review of relevant documents, interview with specialists, site assessment and observations, public and stakeholder consultations, and secondary data collection for establishing the environmental & socio-economic baseline conditions.

Project Description

The Project Development Objective is to strengthen the Africa CDC's regional disease detection and response systems and link them together into an effective network of networks. It will support Africa Centre for Disease Prevention and Control (CDC), Ethiopia and the Southern Africa regional collaborating centre in Zambia to establish infectious disease control systems for the benefit of African Union member states and its citizens. In Ethiopia activities (goods, technical services, and civil works) to be financed by the project, include, inter alia: (i) the design, construction, equipping and furnishing and maintenance of a Biosafety Level 3 (BSL-3) national reference laboratory (NRL) including a laboratory medical equipment maintenance centre; (ii) establishment of a Proficiency Testing System and panel production for standard quality assurance, biobank centre for reference materials of all sorts, central warehouse to serve as logistics supply hub for Africa CDC and the East Africa RCC countries; (iii) construction, equipping and furnishing of 15 laboratories along Ethiopia's borders; (iv) equipping and furnishing 8 Biosecurity Level 2 (BSL-2) district laboratories already constructed by the Global Fund; and (v) a set (4) of programs designed to improve laboratory capacity building and operational effectiveness.

This ESIA report presents findings of the assessment which was conducted to identify potential environmental and social impacts associated with the proposed BSL3 national reference laboratory complex and mitigation strategies for the likely impacts. In addition, a standalone Infection Control and Waste Management Plan (ICWMP) has been prepared for the management of potential environmental and social risks associated with the BSL3 national reference laboratory complex. For

the BSL2 laboratories, an Environmental and Social Management Framework has been prepared. The ESIA, ESMP and the Infection Control and Waste Management Plan (ICWMP) will be updated during implementation (i.e. during the BSL3 lab complex design stage before civil works begin) to consider environmental and social issues associated with decommissioning old incinerators, wastewater management system and the capacity of Kotebe waste treatment plant and Sandafa Sanitary landfill for handling of incineration residues and wastewater sludge.

The BSL-3 national reference laboratory will be designed and operated in accordance with guidance for BSL-3 laboratories established by reputable international organizations (CDC 1999, NIH 2001, WHO 2004). The laboratory complex will be tested for verification that the design and operational parameters have been met prior to operation.

Legal, Policy and Administrative Framework

Ethiopia has several Acts and Regulations related to Environmental Social and Impact Assessment (ESIA) and healthcare waste management. The Ethiopian legal and policy framework applicable for this project include:

- Environmental Policy of Ethiopia
- Environmental Proclamation 299/2002, Environmental Impact Assessment
- Proclamation 513/2007, Solid Waste Management
- Proclamation 300/2002, Environmental Pollution Control
- EIA Procedural Guideline, July 2004
- The Guideline for Waste Handling and Disposal in Health Facilities (2006)

Two of the World Bank Safeguards Policies, namely OP/BP 4.01 and OP 4.11 are also applicable to this project and have been triggered. The fact that the proposed BSL 3 laboratory project activities would largely entail construction of new buildings within EPHI premises, which is already owned by the proponent, it will not seek involuntary acquisition of land and hence will not trigger OP/BP 4.12 on Involuntary Resettlement. Ethiopia has ratified several international/multilateral environmental conventions and many of the principles and provisions in those conventions have been well addressed in the national environmental policies and regulations. Because Ethiopia ratified different conventions, it has international obligations on proper management of hazardous wastes and minimization of dioxins emission. This has implications for the medical waste management and proper operation of incinerators. Air emission from incineration of decontaminated wastes and effluents from the proposed BSL3 national reference laboratory should fulfil the requirements of the relevant World Bank Group Environment Health and Safety Guidelines including the General Guidelines, industry specific guidelines for Healthcare Facilities and Waste Management. The project will also be in compliance with Good International Industry Practices (GIIP) such as WHO guidelines for healthcare facilities and laboratory biosafety

This project has been considered as an environmental assessment category A project. This is because: 1) the occupational and public health risk associated with highly sophisticated BSL-3 lab; 2) the risk associated with medical waste incinerators; 3) the risk associated with medical wastewater; 4) the proposed BSL-3 lab and on-site wastewater management facilities are in densely populated area in Addis Ababa; and 5) the existing waste management infrastructure and management system are inadequate.

Environment and Socio-Economic Baseline

Addis Ababa lies at an elevation of 2,200 metres and located at coordinates 9°1'48"N 38°44'24"E. According to 2007 population census, a total population of Addis Ababa was 2,739,551, but the city's recent population annual growth rate is high with an estimated total population of about 4 million as of 2017. Addis Ababa is a Capital of Ethiopia and the seat of the African Union (AU), and a Chartered City; having three layers of Government: City Government at the top, 10 Sub City Administrations in the Middle, and 99 Kebele Administrations at the bottom. Moreover, Addis Ababa is home to 25% of the urban population in Ethiopia and is one of the fastest growing cities in Africa. The economy is growing annually by 14%. However, the estimated unemployment level in Addis Ababa is 23.5 % and the estimated poverty level is 22%.

The proposed BSL 3 NRL project will be situated within the campus premises of the Ethiopian Public Health Institute (EPHI) which is found in Gullele Sub City, Woreda 09, on Swaziland Street. There are residential and business facilities around EPHI campus which include Commercial Bank of Ethiopia (about 1.5 km), Ethiopian Pharmaceuticals Supply Agency (about 1km), Shops (about 1km), Pharmacies (about 1km), and health care facilities (about 2km). In Addis Ababa, sewage disposal is the responsibility of the Addis Ababa Water Supply and Sewerage Authority (AAWSSA). It operates with seventeen wastewater treatment plants and the main ones are Kality and Kotebe The Kality Wastewater Treatment Plant had capacity to treat 7,600 m³ wastewater treatment per day but recently it has been upgraded with additional investment and technology so that it could treat 100,000 m³ wastewater per day. The Kotebe treatment plant (with capacity of 85,000 m³/day) receives only sludge from vacuum trucks that empty septic tanks.

Alternative analysis

Different project alternative options were considered including the “no action” alternative was considered to evaluate the scenario in the absence of the project taking place. The “No action” option was not be preferred for several reasons. Firstly, Ethiopia's public health system is continually tested by both recurrent and unexpected disease outbreaks and faces the continual challenge of managing the health consequences of natural and manmade disasters, crises, and conflict. Moreover, Ethiopia's proximity to multiple fragile states and its status as a major land and air transportation hub greatly exacerbates its own vulnerability to epidemic disease simultaneously with exposing the African continent to the potential undetected rapid spread of such diseases.

Various alternatives for management of hazardous medical wastes have been considered. The incinerator which are currently found in Ethiopian Public Health Institute are old and do not fulfil the emission requirements of the World Bank EHS guideline. Hence, they will be decommissioned from the site following manufacturer's recommendations and procedures before BSL 3 NRL complex becomes operational. Hence, the following options were considered for management of solid infectious solid medical wastes. First, transportation of the decontaminated solid medical wastes from the BSL3 lab to an existing national centralized medical waste incineration facility located 90 Km away from Addis Ababa. Nevertheless, this option is risky and expensive in the context of Ethiopia. The second option is on-site treatment using pyrolysis incinerator with a capacity to burn 50 kg per hour with emission reduction device control (Fabric filter coated with catalyst) made from PTFE, with parallel dedusting, lower contamination of filter dusts because of PCDD/PCDF destruction at the catalytic surface that have high efficiency reduction of dioxin up to <0.1 ng TEQ/m³. The second option is the

preferred option at this stage. However, since this project will finance the design (and feasibility study) of the BSL3 lab during project implementation, the current ESIA will be updated (together with the relevant ESMP) before civil works are contracted (or commence). Updating of the ESIA, ESMP and ICWMP during implementation will also cover the decommission of the existing old incinerators.

Fly ash and bottom ash from incineration is generally considered to be hazardous, because of the waste would have a heavy metal content and dioxins and furans. The waste will be collected and then solidified with cement/ encapsulated in double containers made from polyethylene material to transport in safe manner to disposal site utilized by Kotebe waste treatment plant for landfilling. As plan B, Sendafa Sanitary landfill will be considered for final disposal of handling incineration residues if this would be socially and environmentally feasible. The updating of the ESIA, ESMP and ICWMP during implementation will also consider the assessment of the capacity of Kotebe waste treatment plant and Sendafa sanitary landfill for handling incineration residues.

Wastewater (Effluent) Management Alternatives: Use of a public sewer line is one of the options considered for treating and disposing liquid waste generated from the proposed BSL 3 lab at the municipal main or trunk sewer. This involves the construction of system to connect the municipal sewer line and it is inexpensive. However, this alternative is not possible currently because there is no municipal main or trunk sewer to which an EPHI sewer system could be connected. The proposed NRL project will develop its own septic tank at EPHI to dispose its own sewage. Septic tanks would be constructed according to US EPA or international standard and monitored to avoid ground water pollution. The BSL 3 laboratory will establish an appropriate liquid waste treatment and management methods. A designated waste treatment facility will be constructed in the institute. Therefore, the design of the BSL 3 lab complex will also consider the waste water treatment system. The system will be designed in such a way to reduce the level of pollution load which can primarily be defined in terms of BOD, COD, total organic carbon, oil and grease, total coliform etc. Reference would be made to standards for effluent discharge into public sewers specified in the World Bank Group EHS guideline. As it is the case for final disposal of handling incineration residues, Sendafa Sanitary landfill also will be considered for final disposal of wastewater sludge if this would be socially and environmentally feasible. Updating of the ESIA, ESMP and ICWMP will also consider the assessment of the capacity of Kotebe waste treatment plant and Sendafa sanitary landfill for wastewater sludge.

Consultation of Stakeholders and information disclosure

Consultation with relevant stakeholders (from community representatives, representatives of religious institution and with members of the different sector offices and participants from the EPH) was conducted in the following stages: i) during early data collection stage (January 22, 2019) ii) on the first draft ESIA (February 28, 2019) and iii) on the final draft ESIA (May 2, 2019). The consultation helped to identify the concerns of the stakeholders. It also enabled the stakeholders to have awareness on and feedback on mechanisms proposed for management of environmental and social risks associated with the BSL3 national reference laboratory complex. consultation was conducted at the Ethiopian Public Health Institute with participants drawn from elders, representatives of religious institution and with members of the different sector offices and participants from the EPHI. The Final ESIA has also been publicly disclosed on the website of the client 03 July 2019 and by the World Bank on 08 July 2019.

Environmental and Social Impacts and Mitigation Measures for the BSL3 NRL Complex

Construction phase

The potential environmental effects anticipated to occur during construction phase are mainly concentrated with the working area. Construction phase will result on land degradation, creation of waste leftover from construction materials, local air pollution, leakages of waste waters as a result of certain processes, as well as with requirements toward safety at work, etc. For prevention of such adverse effects a set of measures has been proposed, like fulfilment of workers safety norms foreseen in the Construction Law.

Impacts on Ecological Resources and Biodiversity: The EPHI BSL3 National reference laboratory Building will be constructed at existing EPHI compound and hence will have reduced impact on threatened or endangered species habitat or buffer areas. A small portion of vegetation and trees would be removed under foundation footings and other parts of the building's base. As mitigation, limit extent of vegetation and tree clearing and replant and re-vegetation clearing/Re-vegetating areas promptly.

Impact on Geology/Soils: Except for the temporary disturbance of up to a depth of a few feet on parts of one-quarter acre of land during site preparation and construction, there would be a very minor/negligible effect upon geology, soils, or seismicity. To minimize it, soil erosion prevention measures would be in place during the construction phase to minimize erosion from storm water;

Impact due to improper construction and demolition waste management: Demolishing and construction of the existing building and construction activities will result in generation of waste. This solid waste would probably be disposed at the Addis Ababa landfill area. Additionally, the project could generate very minor amounts of excess uncontaminated soil from excavation activities. Construction and demolition wastes should be segregated and separated for recycling of some useful waste materials and Hazardous waste will not be mixed with other solid waste generated and would be managed by way of incineration or land-filling.

Occupational health safety (OHS) Risks: All workers including new entrants will be oriented/inducted on safe work practices and ensure that they adhere to it. Regular drills would constantly follow on various possible incidences. Appropriate signage will be posted to warn staff and/or visitors that are not involved in construction activities of dangerous places. Accidents: contractor will adopt best transport safety practices with the goal of preventing traffic accidents and minimizing injuries suffered by project personnel and the public.

Electrical and Explosive Hazards: All Equipment need electric power, without provisions for electrical safety, there is a risk of electric hazard in the site. Exposed or faulty electrical devices, such as circuit breakers, panels, cables, cords and hand tools, can pose a serious risk to workers. In addition, most of the construction equipment use gasoline so that they would be gasoline containers risk of explosive. All laboratory electrical equipment would be earthed/grounded, preferably through three-prong plugs and gasoline would be placed away from fire.

Traffic accident impacts; Construction activities may result in a significant increase in number of vehicles during transport of construction materials and equipment, which will lead to increasing risk of traffic-related accidents or injuries to workers and EPHI community. The project will adhere to the

application of salient practices from the WBG EHS Guidelines for Community Health and Safety in section of Traffic Safety.

Impact on Air quality: Contractors will use dust screens or nets in windows, doorways and ventilators of rooms where demolition or other dusty construction activities are occurring and ensure good housekeeping and clean construction operations. Trucks would be covered during haulage of construction materials and will be diverted away from busy areas of the institute;

Impact of noise and vibrations: Contractor will be careful when selecting equipment to avoid use of old or damaged machinery with high level of noise emissions that would have a negative impact in the environment. Contractors will cordon off construction site with noise absorbing materials; the contractor would ensure that noise levels emanating from machinery, vehicles and noisy construction activities are kept at a minimum for the safety, health and protection of people in the nearby buildings.

Decommissioning of the existing old incinerators: Potential chemical wastes to be generated from the decommissioning and demolition of the incinerators and associated ductworks include residual ash and asbestos-containing materials. substances or chemicals (in any form, quantity and concentration), including asbestos, dioxins, polychlorinated biphenyls (PCBs) and heavy metals (HMs) would cause pollution or constitute a danger to health or risk of pollution to the environment. Decommissioning of the incinerator will be conducted under full containment to avoid the release of any residual ash to the environment, which could be generated during the decommissioning works in both phases.

Operational Phase

The proposed BSL 3 laboratory complex will be expected to generate about 20 kg of solid wastes (gloves, pipette tips, culture tubes, tissues, and other wastes) per day and an average 100 kg per week. Other non-hazardous solid waste would be estimated to be about 5 kg per day with 15 kg per week. All wastes generated in the laboratories of the facility (including sample packaging materials, culture materials, petri dishes, PPE, and associated process wastes) would leave the laboratories only after decontamination using the facility's autoclave or after being chemically sterilized. Disinfected / sterilized wastes will finally be incinerated and disposed of appropriately. Medical wastewater and sanitary liquid waste will be generated from the proposed BSL-3 facility. Sanitary waste would be generated from such activities and from toilets, showers, and sinks in the building bathroom facilities. It is estimated that the BSL3 lab complex will generate a maximum of 360 litres of medical wastewater per week and about 1640 litres of sanitary liquid waste per week. All effluents will be disinfected and drained to a septic tank or cesspool and will finally be treated at the EPHI compound before final disposal.

Impacts on Ecological Resources and Biodiversity: the operation of the proposed BSL-3 lab would have little effects on biodiversity if Infectious microorganisms handled in the proposed BSL3 lab might be introduced into the environment. To avoid these personnel working on the BSL 3 NRL complex would be trained on emergency preparedness and responses and handling of infectious materials and waste management.

Impact of escaping of Infectious Agents from BSL-3 Containment: In the BSL 3 NRL complex, there would be highly infectious agents in storage, analysis or culture processing areas. So, there is a possibility of escaping infectious agents from BSL-3 containment due to hardware failure (HEPA filter), miss use or theft and during sample and waste handling, transportation, and storage. And could cause potential risks resulting in life-threatening for personnel working in the BSL 3 laboratory and

community. As a mitigation strategy, EPHI will ensure the implementing of laboratory access control, regular maintenance of HEPA filter, regular inventory system and training to the employees.

Impact of escaping of Infectious Agents from BSL 2 labs, PTPC and biobank centres: In the PTPC and biobank would be infectious agents in storage, PT diagnosis process or culture. So, that there would be a possibility to escape infectious agents from PTPC and biobank. It could cause potential risks resulting in life-threatening for personnel working in the centre and community. The mitigation measures would be implementing of access control, regular maintenance of HEPA filter, regular inventory activities and training to the employees.

Occupational Health and safety impacts associated with BSL 3 NRL complex operation: Primary hazards to personnel working in Biosafety Level 3 is related with highly infectious agents. Moreover, there are hazards from BSL 2 labs, PTPC and biobank operation. The common routes of exposure to infectious agents are inhalation, inoculation, ingestion and contamination of skin and mucous membranes. Inhalation hazards may arise during work practices that can generate aerosols such as centrifugation, mixing, pouring and spilling of culture fluids. Inoculation hazards may come due to needle sticks and lacerations. Ingestion hazards might be a result of splashes to the mouth, eating food in laboratory, and mouth pipetting, and contamination of skin and mucous membranes can occur via splashes or contact with contaminated fomites. In addition, if the BSL 3 laboratory does not have appropriate work processes, engineering, and administrative controls, the wastes from the laboratory facilities and practices can have serious impact on the community. Moreover, there is also a risk of accidental leakage or spillage from specimens due to poor specimen handling.

As mitigation measures, a containment, good laboratory practices and administrative controls at BSL-3 laboratory facility can reduce the risks, and more emphasis would be given on primary and secondary barriers to protect personnel, community, and the environment from exposure to potentially infectious aerosols. It is therefore essential to maintain high standards of safety in BSL 3 laboratory and recommended safety for BSL 2 labs, PTPC and biobank. Laboratory personnel working in BSL 3 lab, BSL 2 labs, PTPC and biobank must receive specific training in handling pathogenic and potentially lethal agents and would be supervised by senior and competent staff in handling infectious agents and associated procedures. All procedures involving the manipulation of infectious materials would be conducted within BSCs or other physical containment devices and a BSL-3 laboratory must have special engineering and design features. Moreover, the BSL 3 laboratory doors must be self-closing and must be separated from areas that are open to unrestricted traffic flow within the building. To avoid accidental leakage or spillage from specimens, secondary containers, such as boxes, will be used, fitted with racks so that the specimen containers remain upright.

Risk from handling of infectious materials and specimens in the proposed BSL-3 NRL complex: The BSL 3 laboratory, BSL 2 labs, PTPC and biobank are expected to deal with infectious agents during specimen handling. So, there would be a risk of exposure to infectious agents during performing procedures and waste handling. As a mitigation strategy, EPHI would ensure that employees strictly comply with standard operating procedures; properly use and maintain their PPE and obtain the necessary training. Specimen containers would be robust and would not leak when the cap or stopper is correctly applied. No material would remain on the outside of the container. Containers would be correctly labelled to facilitate identification and Standard precautions would always be followed.

Impact of improper use of equipment in the BSL 3 NRL complex: Laboratory workers are at risk for repetitive use of laboratory equipment such as pipetting, centrifuge, BSC homogenizers, shakers,

blenders, sonicators, freezers, autoclave and other equipment. Certain items of equipment may create hazards when they are used, and the common hazards related to laboratory equipment are Aerosols, splashing and tube breakage rotors and impaired ultrasonic hearing, dermatitis, burning, splash and spillage. In addition, due to improper use equipment-related accidents might occur. The mitigation measures would be training of workers in equipment operating and handling techniques during operation, and operation of equipment, periodic maintenance and calibration would be according to the manufacturer's instructions.

Impact of contamination of the BSL 3 NRL complex Facilities: The BSL 3 laboratory performs analysis on the human specimen. So, during the handling and processing of the samples; space, furniture, and equipment could be contaminated by hazardous materials such as infectious agents and chemicals. As a mitigation to maintain safe and sterile work surfaces; a standard operating procedure for properly maintaining, cleaning and disinfecting equipment, work and non-work surfaces would be implemented. In addition, the WHO Laboratory Biosafety Manual 3rd edition, and CDC Biosafety in Microbiological and Biomedical Laboratories (BMBL) will also be implemented.

Potential impact during the operation of Central Warehouse; a large quantities of hazardous chemicals would be stored in the central warehouse. A leaked chemical, especially when it is volatile or a gas at room temperature can cause intoxication and contact with liquefied gases causes severe frostbites in addition. Stored chemicals can also cause accidental fire or explosions resulting health damage, Fire and explosions. As a mitigation, EPHI will implement engineering and administrative control measures to avoid or minimize the release of hazardous substances into the work environment keeping the level of exposure below internationally established or recognized limits.

Impact of fire outbreak: All staff shall have training in fire control through regular firefighting drills. Fire extinguishers will be available in accessible area near to fire risk area and ensure that all fire-fighting equipment is regularly maintained and serviced. Fire hazard signs such as 'No Smoking' signs will be provided. Directions to exit in case of any fire incidence and emergency contact numbers shall be provided. The contact/emergency numbers shall be displayed within the laboratory.

Chemical hazard in the BSL 3 NRL complex building: Occupational chemical exposure may result from laboratory procedures performing and handling of chemicals. All staff would have training in controlling of chemical hazardous and handling. Only amounts of chemicals necessary for daily use will be stored in the laboratory. Implementation of engineering and administrative control measures to avoid the release of hazardous substances into the work environment. Appropriately equipped first-aid stations will be easily accessible throughout the place of work, with Materials Safety Data Sheets (MSDS).

Electrical and explosive hazards in the BSL 3 NRL complex building: In BSL 3 NRL complex there are several types of Equipment needed electrical power. Without provisions for electrical safety, there is a risk of electric for BSL 33 NRL complex. It is essential that all electrical installations and equipment are inspected and tested regularly, including grounding systems. Circuit-breakers and earth-fault-interrupters will be installed in appropriate laboratory electrical circuits. All equipment will be disconnected the attached to high-voltage or high-amperage power sources from the source or provide a lockout device on the breaker. Staff will train of electrical safety.

Ergonomic hazards in the BSL 3 NRL complex building: Laboratory workers are at risk for repetitive motion injuries during routine laboratory procedures such as pipetting, working at microscopes, operating machine and working on BSC workstations. By becoming familiar with how

to control laboratory ergonomics-related risk factors, employers can reduce chances for occupational injuries. Selecting tools and designing work stations that reduce force requirements and holding times, and which promote improved postures, implementing administrative controls into work processes, such as job rotations and rest or stretch breaks.

Impact of air pollution due to waste incineration: Medical waste incinerations emit toxic air pollutants and toxic ash residues that are the major source of dioxins in the environment. To avoid dioxin production, no chlorinated plastic bags (and preferably no other chlorinated compounds) would be introduced into the incinerator. Red bags must not be incinerated as red colour contains heavy metals, which causes toxic emissions. As a mitigation strategy, careful waste segregation and Wastes with polychlorinated dibenzo-dioxins and polychlorinated dibenzo-furans PCDD/Fs would never be incinerated, training programs, as well as attention to materials purchased, will be considered in minimizing the environmental and health impacts. In addition, EPHI would purchase an incinerator that meets WB emission standards (best available technology) and adhere to the best environmental practices recommended by Stockholm convention.

Misuse and/or theft of infectious agent, laboratory equipment/supplies in the BSL 3 NRL complex building: Such a deliberate and/or unexpected misuses and thefts can potentially end up in the release of microorganisms and biological materials that may affect the environment and community health. In addition, in laboratory there are very expensive types of equipment that can be misused and/or stolen. Establish system for physical security, personnel security, material control & accountability, and information security. These measures will be developed to protect against the insider threat, or outsider threat and any natural or manmade events that could cause a release.

Risk associated with collection/handling and storage of waste at BSL 3 NRL complex building: During the operational phase of the BSL 3 laboratory it is anticipated that solid and liquid wastes are generated daily. Most of the wastes generated would be considered as highly infectious. The improper handling, treatment and disposal waste can cause serious health problem for workers, community and environment. As a mitigation measures, BSL 3 NRL complex would adhere to the application of WHO Laboratory Biosafety Manual 3rd edition and WBG EHS Guidelines which represent best practices and experiences in hazardous waste management.

Risks associated with waste transportation within EPHI campus and offsite: Medical waste may contain potential pathological organisms which if improperly managed may be a risk to healthcare staffs and public during transportation of waste. To avoid this, all waste bags would in-place and transportation using carts, trolley, or containers assigned for this purpose only and transport workers would use PPE during handling waste. Moreover, training on waste management would be provided to all waste transport workers. All waste containers designated for off-site shipment would be secured and labelled with the contents and associated hazards and be properly loaded on the transport vehicles before leaving the site, and waste would be placed in rigid, leak-proof containers before being loaded and covered with lids.

Risk associated with final waste disposal: The disposal and storage of these wastes without treatment leads to contamination of surface and groundwater through long term leachate accumulation from the disposal sites and ultimately disturbs the ecological and environmental balance. Personnel working on waste disposable would trained on waste management and they would wear necessarily during waste disposable. Bottom ash would be managed separately from fly ash and other flue gas treatment residues to avoid contamination of the bottom ash for its potential recovery. Fly ash and bottom ash will be collected and then solidified with cement/ encapsulated in double containers made from polyethylene material to transport in safe manner to disposal site utilized by Kotebe waste treatment plants for

landfilling. Alternatively, the homogeneous mixture would be transported in liquid state to Kality wastewater treatment plant and then the treated sludge will be disposed in secured manner at landfilling disposal site utilized by Addis Ababa water and sewerage Authority. As plan B, Sendafa Sanitary landfill will be considered for final disposal of handling incineration residues if this would be socially and environmentally feasible.

Impacts of Improper waste water treatment at EPHI BSL 3 NRL Complex: Several risk factors can reduce the efficiency of the septic tank. The risk can be imparted during designing or operation phase, resulting risk for worker, and community health and environment pollution. EPHI would be transported to AAWSSA Kotebe treatment plants to treat and dispose sludge, using vacuum trucks with empty septic tanks. The waste also needs to meet the standard summarized below table to be discharged into publicly operated sewage collection and treatment systems at Addis Ababa. As it is the case for final disposal of handling incineration residues, Sendafa Sanitary landfill also will be considered for final disposal of wastewater sludge if this would be socially and environmentally feasible.

Analysis of Abnormal Events and Accidents for Facility Operation: The potentially hazardous material to be handled in the proposed BSL 3 facility would consist of highly infectious microorganisms in containers holding liquid suspensions or on semi-solid media. Accident scenarios usually catastrophic events such as earthquake, fire, explosions and airplane crashes, normally considered as initiating events are having the potential to increase risk on highly infectious releases. The accident scenario would be dangerous for workers, the community and environment, causing a serious health problem. BSL 3 NRL would have an emergency preparedness and response plan. In an emergency response mode, the responder would enter only after ascertaining the risk and donning appropriate personal protective equipment.

Emergency Preparedness and Response: An emergency is an unexpected event when the BSL 3 laboratory operation loses control, or could lose control, of a situation that may result in risks to human health, property, or the environment, either within the facility or in the local community. Therefore, the BSL 3 facility emergency preparedness and response plan would be commensurate with the risks of the facility, and an Emergency Preparedness and Response Plan, incorporated into and consistent with, the facility's overall ES/OHS.

Environmental and Social Management Plan (ESMP)

An Environmental and Social Management Plan (ESMP) has been proposed for construction works and operation of laboratory facility. The ESMP identifies potential environmental and social aspects that should be mitigated, parties responsible for implementing and monitoring actions, associated costs, indicators and training or capacity building needs and reporting. Institutional responsibility of implementing this ESMP will be the Project Coordination Team, under Public Health Infrastructure Directorate (PHID) at FMOH. A key role and responsibility of the team would be to review consultants' reports for compliance with the ESMP, monitoring implementation of mitigation actions by contractors, coordinating training and capacity building where planned, periodically report to FMOH about implementation and progress of the ESMP. Monitoring will verify if predicted impacts have occurred and check that mitigation actions recommended in the ESIA are implemented and their effectiveness. Monitoring will also identify any unforeseen impacts that might arise from project

implementation. Monitoring will be undertaken by FMOH PHID directorate and Addis Ababa Environmental Protection Authority (EFCCC) at local administrative.

Various measures have been proposed to improve the client's capacity to manage the risks associated with the project. To maintain regulatory compliance and to protect personnel, the community and the environment from biohazards, EPHI will be responsible for appointing laboratory director, biosafety and biosecurity officer and other technical and support staff required for the BSL-3 lab complex; ensuring appropriate training is provided to personnel conducting research with biohazards; ensuring that research conforms to the provisions of best international practices. The BSL-3 facility will also recruit and deploy HVAC technician, electrical technician, equipment and instrument maintenance technician, security staff, incinerator operator, cleaners, wastewater treatment plant operator. These staff will help to ensure proper implementation of the ESMP and ICWMP; and their roles and responsibilities are described in section 2 of the ESIA.

Procedures, roles and responsibilities for addressing grievances and resolving disputes are also presented under this chapter. Every aggrieved person shall be able to trigger this mechanism to quickly resolve their complaints. In general, the proposed project has potential to significantly improve quality of laboratory, and efficiency of service provision in the national as well as at regional with socio-environmental benefits such as improved medical surveillance and emergency public health management services, resulting reduced morbidity, improved quality of life for the population, and increased productivity of labor. Possible socio-environmental impacts can be adequately controlled with mitigation measures presented in this report.

Capacity building training for ESMP implementation monitoring will be provided to relevant staff of to enhance their skills in environmental monitoring during the operational phases of the NRL BSL-3 laboratory. The budget allocated to support the capacity building will be 79, 500 USD. The overall indicative ESMP and environmental monitoring implementation budget will be **1,337, 275.00 USD**.

**ZAMBIA NATIONAL PUBLIC HEALTH INSTITUTE
MINISTRY OF HEALTH**

**ENVIRONMENTAL AND SOCIAL IMPACT
ASSESSMENT**

Executive Summary

August 2019

Africa CDC Regional Investment Financing Program (P167916)

EXECUTIVE SUMMARY

Background

The Government of Zambia has established the Zambia National Public Health Institute (ZNPHI) as a specialized technical arm of the Ministry of Health responsible for protecting the Public Health security of the country. Zambia also serves as host country for the Africa Centre for Disease Control and Prevention (Africa CDC) Southern Africa Regional Collaborating Center (SA-RCC), which coordinates public health and disease prevention strategies among ten regional Member States (Angola, Botswana, eSwatini, Lesotho, Malawi, Mozambique, Namibia, South Africa, Zambia and Zimbabwe). The ZNPHI through the Ministry of Health has received support from The World Bank through the Africa Centre for Disease Control (CDC) Regional Investment Financing Program (ACDCP). The ACDCP is providing support to three entities: the Africa CDC headquarters; Ethiopia as host country for Africa CDC; and Zambia National Public Health Institute (ZNPHI) and Southern Africa Regional Collaborating Centre (SA-RCC) in Lusaka, Zambia.

In the Zambian component of the Africa CDC financing program, ZNPHI proposes to construct, equip, staff and operate a four-storey purpose-built laboratory and office complex that will comprise a Biosafety Level 3 (BSL-3) Laboratory suite, Public Health Emergency Operations Centre (PHEOC), Information Communication and Technology (ICT) suite, Proficiency Panel Production Center, Biomedical Equipment Maintenance Center, training facilities, Conference facilities and office accommodation to enable it meet both national and regional public health responsibilities. This will provide additional capacity to fulfil obligations in line with the International Health Regulations (IHR) 2005 core capacities, the 2017-2021 Zambia National Health Strategic Plan, and vision of the Africa CDC for strong institutions that support national, regional and international partnerships for disease control and public health security. The laboratory and office complex will be a fixed asset owned by the Government of the Republic of Zambia (GRZ) under the Ministry of Health (MOH).

The main infrastructure is envisioned to be a four-storey building of an inverted “T” shape, with accessory two-storey arc-shaped blocks at its rear. The front of the building will be connected through a central circular façade that will serve as the primary public entrance into the complex. The two rectangular blocks will accommodate the offices, training/seminar rooms, ICT suite, conference facilities and library/resource center. The top two floors of the circular area will house the PHEOC (one floor each for national and regional). The stem of the inverted “T” will be the main laboratory block, with the BSL-3 suite occupying the uppermost floor, while other support laboratories will be on the lower three floors. These will support functions including Virology, Bacteriology, Immunology/Vaccinology, Vector biology & Parasitology, a Molecular biology suite, Chemistry, Haematology, Toxicology and proficiency testing panel production center to support quality assurance programs. The arch-shaped blocks will house the Biorepository and animal health laboratory facilities.

Other accessory features will include a biomedical equipment maintenance center, power substation, onsite industrial autoclave and shredder unit, and waste management system (for both liquid and solid biomedical and domestic waste).

Need for the Project

Zambia currently does not have a dedicated public health laboratory and relies on clinical laboratories which are primarily mandated to support clinical management of patients. The proposed project will address this gap by providing financial and technical assistance for construction, equipping and staffing of a dedicated National Public Health Laboratory at Biosafety Level (BSL3), with associated ICT support for data management and security.

Objectives of the Project

The project objective is to establish resilient public health security capacity, infrastructure and human resource capacity and systems for Zambia and the SA-RCC region, encompassing:

- Surveillance and disease intelligence,
- Effective preparedness and efficient management of public health emergencies and events,
- Efficient Public Health Laboratory Networks,
- Public Health and scientific workforce development
- Generation, management and dissemination of scientific data to support evidence-based formulation of national and regional policies, strategies and programs for public health actions.

ESIA Study Objectives

The main objective of this ESIA study is to identify and assess impacts resulting from the proposed project to the biophysical social and economic environment. Anticipated positive and negative impacts from the proposed project have been assessed in accordance with the Environmental Impact Assessment Regulations established under the Environmental Management Act (EMA), World Bank Safeguards Policies and WHO Laboratory Biosafety Manual.

ESIA Methodology and Approach

A detailed study for the ESIA was undertaken considering the legislative requirements of the Environmental Impact Assessment Regulations of Zambia. During the ESIA study, the key focus was to identify potential environmental, social and cultural impacts of the proposed project and highlight possible mitigation measures for these impacts. The study procedure involved desk review, field visits and observation to collect field baseline data, interviews with stakeholders, photography, geo-referencing and design of an environmental management plan. Field site surveys formed part of the preparation of the ESIA report. The main objective of this activity was to carry out on-site field assessments of the expected effects of the planned developments on the physical, biological and socio-economic environment. Besides, project affected groups were consulted to get their concern about the project and their concerns have been addressed in the proposed mitigation measures.

Legal, Policy and Administrative Framework

The proposed project activities touch on many regulatory instruments which need compliance with. Presented below is some the key Zambian legislation relevant to the project and requiring legal compliance will be applicable.

- Environmental Management Act, 2011
- Environmental Impact Assessment Regulations, 1997
- National Health Research Act, 2013
- Public Health Act, 1995
- The Medicines and Allied Substances, 2013

The World Bank Safeguards Policies, namely OP/BP 4.01 and OP 4.11 are applicable to this project and hence have been triggered. Air emissions from incineration of decontaminated wastes and effluents from the Zambia BSL3 laboratory should comply with the requirements of the World Bank Group Environment Health and Safety Guidelines including the General Guidelines and Guidelines for Healthcare Facilities and Waste Management. The project will also comply with Good International Industry Practices (GIIP) such as WHO guidelines for healthcare facilities and laboratory biosafety.

The Baseline Environment

The BSL3 lab will be located approximately 26km from Lusaka central business district along Palabana road in Silver Rest, Chongwe district. The project site is approximately 4.8km at the terminal end of the newly tarred Silverest road from Silverest primary school on Great East Road. The tarred road leading to the project site branches off from the Great East road (T2) at Silverest primary school, 9km from the airport roundabout. The central GPS coordinates for the 10-hectare project site are; Latitude 15°23' 38 South and Longitude 28°28 41' East. Air quality in the project area is generally good although pollutants generated by vehicle exhaust emissions and dust raised by traffic passing through the area contributes to deterioration of the ambient air quality, especially when local inversions are experienced. Apart from vehicular traffic, other sources of air pollution include the burning of fuel (wood and charcoal) in townships and informal settlements and the burning of bush and scrub as well as charcoal burning in surrounding areas around Silver Rest, especially during the dry season. Increases in fugitive dust levels, particularly under hot and dry conditions, also periodically results in the deterioration of air quality.

The project site is found in an upcoming mixed-use area with infrastructural developments such as Silver Rest Gardens, subsistence and commercial farms and government institutions. In the eastern part of the proposed site, the main sources of livelihood include subsistence agriculture (crops, livestock), charcoal burning and selling, trading, beer brewing, and “wild” natural resources, including trees, grasses, nuts, fruits, and medicinal plants. The most ubiquitous activity is agriculture - virtually all households in the village grow crops. The Project site is in close proximity with different social receptors police post (located approximately 1km from the proposed site location), north east of the site, also located 5.17km in the north direction of the site is Silver Rest primary school and Silver Rest gardens residential estate is located 3.4 km, north of the site.

Project alternatives

Various project alternatives were taken into account including no project alternative. The no action alternative was not preferred as Zambia currently lacks a dedicated public health laboratory system and relies on the already overloaded clinical laboratories whose core mandate is to provide diagnostic services to support the clinical management of patients in hospitals. The alternative analysis has therefore focused on analysis of options for medical waste management, water supply, energy supply, and project site. The ZNPHI shall have a central autoclaving system for sterilisation of health care solid waste. Health care solid waste from the BSL -3 laboratory will be initially autoclaved within the laboratories as per BSL -3 biosafety requirements. The sterilised solid waste will then be conveyed to the central solid waste autoclaving system for secondary autoclaving. From the central autoclaving system, sterilised solid waste will be shredded to reduce on the volume. The shredded waste, now rendered as safe as domestic waste, will be held temporarily until scheduled for transport to the designated (Chunga) landfill. Where required, ZNPHI will outsource incineration services from ZAMRA. The ZAMRA incinerators are capable of handling medical and pharmaceutical wastes. As per current practice, the ash from the incinerators will be transported by trucks and disposed of at the Chunga landfill site. The BSL3 lab complex will have two separate wastewater networks for management of healthcare waste effluent and domestic waste effluent.

The medical wastewater will be collected into a leak proof storage tank whose filling capacity will be auto monitored so as not to exceed $\frac{3}{4}$ full. The wastewater will then be steam sterilised using the liquid cycle of the autoclave connected to the storage tank. The autoclaved wastewater will then be discharged into the solid particle filtration system to allow solid particles to be filtered out of the waste water as it flows through the system. The filtered waste water will be collected in the retention tanks which will be vacuum tanked by licenced waste collectors for further treatment at the offsite municipal sewage treatment site (Manchinchi Wastewater Treatment Plant) at regular intervals. The domestic waste water network will have several inspection chambers as it leads to the sedimentation tanks. A layer of accumulated solids or sludge will form at the bottom of the sedimentation tank as the waste water slowly flows through it thereby providing a level of purification prior to discharge. The sludge at the bottom of the sedimentation tanks will be

periodically removed during routine maintenance and will be disposed of at Manchinchi Wastewater Treatment Plant site.

The preferred source of energy use in the BSL-3 facility is from the national grid. However, the project will install a stand by generator for the facility for emergency purposes only. The preferred source of water for this project is borehole water with plans by the project to drill a borehole to provide water for the BSL-3 facility. Pipe water from the water utility was rejected due to the lack of a water supply system. International best practices will be considered in designing the lab. The BSL-3 laboratory which is going to be constructed at ZNHIP would be designed and operated in accordance with guidance established by reputable international organizations (CDC 1999, NIH 2001, WHO 2004).

Public Consultation and Information Disclosure

The study team consulted with stakeholders including government authorities, the community and relevant organizations involved directly and indirectly with the proposed project to seek their views on the impacts (adverse and beneficial) of the proposed project on the environment and socio-economic characteristics of the project area. The ESIA team conducted a stakeholder mapping and analysis to identify potential stakeholders and their level of interest as regards the project. Consultations with identified stakeholders were carried out through key stakeholder/informant engagements and public meetings. This was done in December 2018 and July 2019. Feedback from the consultations was incorporated in developing project mitigation measures.

On 16th July 2019, a public consultative and disclosure meeting on the project was held at the Ministry of Health Headquarters and attended by a wide representation of stakeholders including community members, local leaders, cooperating partners, MOH senior leadership, NGO, and government agencies (Annex 6). The meeting was chaired by the Honorable Minister of Health Dr Chitalu Chilufya and the area Chiefdom, the Busoli royal establishment (BRE), was represented by Princess Cholwe Nkomeshya. Following description of the various aspects of the project by the ZNPHI Director Dr Victor Mukonka, an open question and answer session was held, during which the stakeholders sought clarity on a number of issues. These centered mainly around security and safety matters, institutional relationships/roles, and benefits of the project to the local community and the nation at large. Overall there was acceptance and support for the project. This position was also echoed by the BRE through Princes Cholwe, who pledged full support and expressed gratitude to the Government for considering setting up the infrastructure and investment in the Busoli Chiefdom. The final ESIA has been publicly disclosed in the website of the client on 01 August 2019 and by the Bank on 02 August 2019.

Environmental and Social Impacts and Mitigation Measures

The major environmental and social impacts that are likely to arise from the construction and operational phases as well as mitigation measures for the risks are summarized in the table following:

Adverse Impacts and Mitigation Measures (Construction Phase)

Environmental / Social Impact	Mitigation Measures
Traffic Congestion	<ul style="list-style-type: none"> <input type="checkbox"/> Provide and implement a traffic management plan <input type="checkbox"/> Provision temporary road signs or notices to indicate ongoing works. <input type="checkbox"/> Effecting traffic controls to avoid congestion and accidents on construction site and associated roads. <input type="checkbox"/> Choosing suitable traffic routes to reduce the impact in the neighbourhood. <input type="checkbox"/> Ensuring no interference with traffic through traffic control, designated parking, speed limits and hiring a banksman.
Site Related Oil Spills	<ul style="list-style-type: none"> <input type="checkbox"/> Employee awareness on company procedures for dealing with spills and leaks from oil storage tanks.

Environmental / Social Impact	Mitigation Measures
	<ul style="list-style-type: none"> <input type="checkbox"/> Containment of leaks. <input type="checkbox"/> Provision of absorbent material <input type="checkbox"/> Maintenance of contractor's plant <input type="checkbox"/> Provision of relevant emergency numbers
Soil Related Impacts	<ul style="list-style-type: none"> <input type="checkbox"/> Stock piling of soil for reuse <input type="checkbox"/> Provision temporary drainage channels or holding ponds as a precautionary measure <input type="checkbox"/> Restoration of the ground by planting adequate grass cover and trees. <input type="checkbox"/> Planning emergency response measures in case of accidental oil spills.
Impact on Water Resources	<ul style="list-style-type: none"> <input type="checkbox"/> Provide a waste management plan <input type="checkbox"/> Proper solid and liquid wastes disposal mainly from the construction camps, sites and offices. <input type="checkbox"/> Ensuring proper measures are in place for collection and disposal of spilled oils and lubricants.
Influx/Immigration	<ul style="list-style-type: none"> <input type="checkbox"/> Hiring unskilled construction and skilled (if available) labour from the local population as far as possible. <input type="checkbox"/> Use of manual labour during excavation and construction works where possible. <input type="checkbox"/> Prepare a labor influx plan to manage labor influx <input type="checkbox"/> Sensitizing workers and the surrounding community on awareness, prevention and management of HIV/AIDS. <input type="checkbox"/> Enforcing and maintaining a code of conduct for employees
Air Quality	<ul style="list-style-type: none"> <input type="checkbox"/> Use of personal protective clothing (PPE) like dust masks on construction crew. <input type="checkbox"/> Operated and maintenance of contractor's plant in compliance with relevant vehicle emission standards and manufacturer's specification to minimize air pollution.
Noise Pollution	<ul style="list-style-type: none"> <input type="checkbox"/> Use of personal protective clothing (PPE) like dust masks on construction crew. <input type="checkbox"/> Avoiding night time construction when noise is loudest near residential areas. <input type="checkbox"/> No discretionary use of noisy machinery within 50 m of residential areas and near institutions or use of manual labour in these sections. <input type="checkbox"/> Good maintenance and proper operation of construction machinery. <input type="checkbox"/> Where possible, ensure non-mechanized construction to reduce the use of machinery
Impact on flora and fauna	<ul style="list-style-type: none"> <input type="checkbox"/> Re-planting the indigenous vegetation as much as possible once work is completed. <input type="checkbox"/> Sparing the vegetation that must not necessarily be removed. <input type="checkbox"/> Provide a waste management plan <input type="checkbox"/> Promoting non-mechanized methods of construction. Ensure that the employees on site are aware of the company procedures for dealing with spills and leaks from oil storage tanks <input type="checkbox"/> Provision of dustbin and sanitation facilities.

Environmental / Social Impact	Mitigation Measures
Public Health & Safety	<ul style="list-style-type: none"> <input type="checkbox"/> Ensuring proper maintenance and operation of Contractors' machinery to mitigate noise and dust impacts. <input type="checkbox"/> Providing crossing areas for access to pedestrians to minimise accidents. <input type="checkbox"/> Provide workers with adequate drinking water and breaks. <input type="checkbox"/> Drain all pools of standing water to minimize or altogether eliminate mosquito breeding sites. <input type="checkbox"/> Provide a waste management plan. <input type="checkbox"/> Cordon off trenches and working areas with a reflective tape to ensure safety of pedestrians and provide crossing areas
HIV & AIDS Impacts	<ul style="list-style-type: none"> <input type="checkbox"/> Sensitizing workers and the surrounding communities on awareness, prevention and management of HIV/AIDS. <input type="checkbox"/> Provide an on-site clinic to provide VCT services to construction crew.
Gender empowerment	<ul style="list-style-type: none"> <input type="checkbox"/> Ensuring equitable distribution of employment opportunities between men and women <input type="checkbox"/> Providing toilets and bathrooms for both male and female workers on site
Child Labour and Protection	<ul style="list-style-type: none"> <input type="checkbox"/> Provide and implement a child protection strategy <input type="checkbox"/> Ensuring no children are employed on site in accordance with national labour laws <input type="checkbox"/> Ensuring that any child sexual relations offenses among contractors' workers are promptly reported to the police
Gender Equity, Sexual Harassment	<ul style="list-style-type: none"> <input type="checkbox"/> Provide and implement a gender-based violence strategy, which will include: <input type="checkbox"/> Gender mainstreaming in employment at the worksite with opportunities provided for females to work, in consonance with local laws and customs <input type="checkbox"/> Grievance redress mechanisms including non-retaliation. <input type="checkbox"/> Provide and implement an employee code of conduct <input type="checkbox"/> The works contractor should be required, under its contract, to prepare and enforce a No Sexual Harassment and Non-Discrimination Policy, in accordance with national law where applicable.
Liability for loss of life, injury or damage to private property	<ul style="list-style-type: none"> <input type="checkbox"/> Provision of PPE. <input type="checkbox"/> Training workers on the operation of the machinery and equipment <input type="checkbox"/> Ensuring there are adequate warning and directional signs. <input type="checkbox"/> Ensuring that the prepared code of conduct for staff is followed to prevent accidents. <input type="checkbox"/> Developing a site safety action plan. <input type="checkbox"/> Cordoning off unsafe areas <input type="checkbox"/> Provision of first Aid kit within the construction site. <input type="checkbox"/> Recording of all injuries that occur on site in the incident register, corrective actions for their prevention are instigated as appropriate. <input type="checkbox"/> Compliance with the Workmen's Compensation Act, ordinance regulations and union agreements.
Ecological impact (It is anticipated that small scale vegetation clearing activities during the construction phase of the project may result in loss of flora and fauna).	<ul style="list-style-type: none"> <input type="checkbox"/> To minimise this, ZNPHI will ensure all vegetation clearance are restricted to the project footprint
Excavation activities during construction phase of the project may lead to soil instability and erosion at the project site while	<ul style="list-style-type: none"> <input type="checkbox"/> As much as possible excavated soil will be re-used on the site as backfill and will be compacted to make it stable. All cut slopes, embankments, and other erosion- prone working areas will be stabilized to any feasible extent

Environmental / Social Impact	Mitigation Measures
movement of construction equipment and machinery would lead to compaction of top soil.	

Adverse Impacts (Operation Phase)

Environmental / Social Impact	Mitigation Measure
Wastewater generated by the facility during the operational phase has potential to pollute surface and groundwater through surface drainage regimes and infiltrating the underlying aquifer.	<input type="checkbox"/> ZNPHI shall ensure effective solid waste management and wastewater from the laboratories will be collected and channelled to a collection tank linked to decontamination and disinfection equipment for primary treatment. The decontaminated and disinfected waste water will then be channelled into the interceptor tanks for secondary treatment before being transported to a waste water treatment facility. In addition, ZNPHI developed an Infection Prevention, Control and Waste Management Plan (IPCWMP)
Impacts associated with inadequate BSL-3 Facility Design leading to among others: (Human Health Risks, Occupational Health and Safety Risks, Community Health and Safety Risks, Environmental Risks)	<input type="checkbox"/> Ensure the BSL-3 Facility is designed in accordance with the design requirements provided by WHO Laboratory Biosafety Manual)
Impacts associated with NON-Commissioning of the BSL-3 Facility design leading to among others: - (Human Health Risks, Occupational Health and Safety Risks, Community Health and Safety Risks, Environmental Risks)	<input type="checkbox"/> Ensure that the BSL-3 Facility is commissioned as per the requirements and in accordance with the design requirements provided by WHO Laboratory Biosafety Manual).
Impacts associated with NON-CERTIFICATION of the BSL-3 Facility design leading to among others: - (Human Health Risks, Occupational Health and Safety Risks, Community Health and Safety Risks, Environmental Risks)	<input type="checkbox"/> Ensure that the BSL-3 Facility is commissioned as per the requirements and in accordance with the design requirements provided by WHO Laboratory Biosafety Manual). <input type="checkbox"/> Ensure that on an annual basis, re-certification of the BSL-3 Facility is undertaken by an independent expert.
Impact associated with Workers' Chemical Exposure leading to Occupational Health and Safety Risks,	<input type="checkbox"/> Provide training to workers in the BSL-3 and ensure they have proper knowledge of the toxic effects of these chemicals, the routes of exposure and the hazards that may be associated with handling and storage. <input type="checkbox"/> Material safety data sheets or other chemical hazard information should be available from chemical manufacturers and/or suppliers. These should be accessible in laboratories where these chemicals are used, e.g. as part of a safety or operations manual. <input type="checkbox"/> Ensure that there are Biological Safety Cabinets (BSCs) (Class III) in the BSL-3 designed to protect the operator, the laboratory environment and work materials from exposure to infectious aerosols and splashes

Environmental / Social Impact	Mitigation Measure
	that may be generated when manipulating materials containing infectious agents, such as primary cultures, stocks and diagnostic specimens.
Impacts associated with inadequate management of infectious solid waste from the BSL-3 Facility to among others: - (Human Health Risks, Occupational Health and Safety Risks, Community Health and Safety Risks, Environmental Risks)	<input type="checkbox"/> Develop a solid waste management plan for infectious and hazardous solid wastes with WHO Laboratory Biosafety Manual <input type="checkbox"/> Autoclave all infectious and hazardous solid wastes <input type="checkbox"/> Incinerate infectious and hazardous solid wastes in an incinerator that meets the specifications for incinerating wastes from BSL-3 facility <input type="checkbox"/> Provide training for workers handling for infectious and hazardous solid wastes <input type="checkbox"/> Provide PPE for workers handling for infectious and hazardous solid wastes
Impacts associated with inadequate management of infectious effluent/liquid waste from the BSL-3 Facility leading to among others: - (Human Health Risks, Occupational Health and Safety Risks, Community Health and Safety Risks, Environmental Risks)	<input type="checkbox"/> Develop a liquid waste management plan for infectious and hazardous solid wastes in accordance with WHO Laboratory Biosafety Manual <input type="checkbox"/> Autoclave all infectious and hazardous liquid wastes <input type="checkbox"/> Provide training for workers handling for infectious and hazardous liquid wastes <input type="checkbox"/> Provide PPE for workers handling for infectious and hazardous liquid wastes
Impacts associated with inadequate disinfection of BSL-3 Facility leading to among others: - Occupational Health and Safety Risks)	<input type="checkbox"/> All items within BSCs, including equipment, should be surface-decontaminated and removed from the cabinet when work is completed, since residual culture media may provide an opportunity for microbial growth. The interior surfaces of BSCs should be decontaminated before and after each use. <input type="checkbox"/> The work surfaces and interior walls should be wiped with a disinfectant that will kill any microorganisms that might be found inside the cabinet. <input type="checkbox"/> At the end of the work day, the final surface decontamination should include a wipe-down of the work surface, the sides, back and interior of the glass. A solution of bleach or 70% alcohol should be used where effective for target organisms. A second wiping with sterile water is needed when a corrosive disinfectant, such as bleach, is used. <input type="checkbox"/> BSCs must be decontaminated before filter changes and before being moved. The most common decontamination method is by fumigation with formaldehyde gas. BSC decontamination should be performed by a qualified professional.
Impacts associated with specimen exposure of BSL-3 Facility leading to among others: - Occupational Health and Safety Risks)	<input type="checkbox"/> To avoid accidental leakage or spillage, secondary containers, such as boxes, should be used, fitted with racks so that the specimen containers remain upright. The secondary containers may be of metal or plastic, should be autoclavable or resistant to the action of chemical disinfectants, and the seal should preferably have a gasket. They should be regularly decontaminated. <input type="checkbox"/> The facility should designate a receipt of specimen room or area designated for this purpose. <input type="checkbox"/> Personnel who receive and unpack specimens should be aware of the potential health hazards involved and should be trained to adopt standard precautions (2), particularly when dealing with broken or leaking containers. <input type="checkbox"/> Primary specimen containers should be opened in a biological safety cabinet. Disinfectants should be available.

Environmental / Social Impact	Mitigation Measure
	<input type="checkbox"/> Every laboratory that works with infective microorganisms should institute safety precautions appropriate to the hazard of the organisms and the animals being handled.
Impacts associated with Emergency Hazards from the BSL-3 Facility design leading to among others: - (Human Health Risks, Occupational Health and Safety Risks, Community Health and Safety Risks, Environmental Risks)	<input type="checkbox"/> Develop a Contingency Plan Procedure for the BSL-Facility <input type="checkbox"/> Provide First-aid kit, including universal and special antidotes <input type="checkbox"/> Provide Appropriate fire extinguishers, fire blankets <input type="checkbox"/> Full protective clothing (one-piece coveralls, gloves and head covering – for incidents involving microorganisms in Risk Groups 3) <input type="checkbox"/> Full-face respirators with appropriate chemical and particulate filter canisters <input type="checkbox"/> Room disinfection apparatus, e.g. sprays and formaldehyde vaporizers <input type="checkbox"/> Hazard area demarcation equipment and notices
Impacts associated with Fire Hazards from the BSL-3 Facility design leading to among others: - (Human Health Risks, Occupational Health and Safety Risks, Community Health and Safety Risks, Environmental Risks)	<input type="checkbox"/> Fire-fighting equipment should be placed near room doors and at strategic points in corridors and hallways. This equipment may include hoses, buckets (of water or sand) and a fire extinguisher. Fire extinguishers should be regularly inspected and maintained, and their shelf-life kept up to date. <input type="checkbox"/> Close cooperation between safety officers and local fire prevention officers is essential. <input type="checkbox"/> The assistance of local fire prevention officers in the training of laboratory staff in fire prevention, immediate action in case of fire and the use of fire-fighting equipment is desirable. <input type="checkbox"/> Fire warnings, instructions and escape routes should be displayed prominently in each room and in corridors and hallways.
Impacts associated with Electrical Hazards from the BSL-3 Facility design leading to among others: - (Human Health Risks, Occupational Health and Safety Risks, Community Health and Safety Risks, Environmental Risks)	<input type="checkbox"/> It is essential that all electrical installations and equipment are inspected and tested regularly, including earthing/grounding systems. <input type="checkbox"/> Circuit-breakers and earth-fault-interrupters should be installed in appropriate laboratory electrical circuits. <input type="checkbox"/> All laboratory electrical equipment should be earthed/grounded, preferably through three-prong plugs. <input type="checkbox"/> All laboratory electrical equipment and wiring should conform to national electrical safety standards and codes.
Impacts associated with Noise Hazards from the BSL-3 Facility design leading to among others: - Occupational Health and Safety Risks.	<input type="checkbox"/> Where noise levels cannot be abated and where laboratory personnel routinely experience excessive exposures, a hearing conservation program that includes the use of hearing protection while working in hazardous noise and a medical monitoring program to determine the effect of noise on the workers should be instituted. <input type="checkbox"/> Noise measurement surveys be conducted to determine the noise hazard. <input type="checkbox"/> Where warranted by data, engineering controls such as enclosures or barriers around noisy equipment or between noisy areas and other work areas, can be considered
Impacts associated with Ionizing Radiation Hazards from the BSL-3 Facility leading to among others: - Occupational Health and Safety Risks.	To limit the harmful effects of ionizing radiation, the use of radioisotopes should be controlled and should comply with relevant national standards. Protection from radiation is managed on the basis of four principles: <ul style="list-style-type: none"> <input type="checkbox"/> Minimizing the time of radiation exposure <input type="checkbox"/> Maximizing the distance from the radiation source <input type="checkbox"/> Shielding the radiation source <input type="checkbox"/> Substituting the use of radionuclides with non-radiometric techniques. <input type="checkbox"/> Mark radiation containers with the radiation symbol, including radionuclide identity, activity and assay date <input type="checkbox"/> Use radiation meters to monitor working areas, protective clothing and hands after completion of work.

Environmental / Social Impact	Mitigation Measure
	<ul style="list-style-type: none"> <input type="checkbox"/> Use appropriately shielded transport containers <input type="checkbox"/> Remove radioactive waste frequently from the working area. <input type="checkbox"/> Maintain accurate records of use and disposal of radioactive materials. <input type="checkbox"/> Screen dosimetry records for materials exceeding the dose limits. <input type="checkbox"/> Establish and regularly exercise emergency response plans. <input type="checkbox"/> In emergencies, assist injured persons first. <input type="checkbox"/> Clean contaminated areas thoroughly. <input type="checkbox"/> Request assistance from the safety office, if available. <input type="checkbox"/> Write and keep incident reports.
<p>Impacts associated with transport of infectious samples and specimens (including wastes) to and from the BSL-3 Facility leading to among others: -</p> <p>(Human Health Risks, Occupational Health and Safety Risks, Community Health and Safety Risks, Environmental Risks)</p>	<ul style="list-style-type: none"> <input type="checkbox"/> Use the protocol for transportation and shipment of specimen and wastes in accordance with the United Nations Model Regulations on the Transport of Dangerous Goods (40) and local country laws (Annex 7). <input type="checkbox"/> Provide training to workers in the BSL-3 and ensure they have proper knowledge of the toxic effects of these chemicals, the routes of exposure and the hazards that may be associated with handling and storage. <input type="checkbox"/> Material safety data sheets or other chemical hazard information should be available from chemical manufacturers and/or suppliers. These should be accessible in laboratories where these chemicals are used, e.g. as part of a safety or operations manual. <input type="checkbox"/> Laboratory personnel must ship infectious substances according to applicable transport regulations. <input type="checkbox"/> Develop a Spill Clean Up Procedure
<p>Impacts associated with inadequate or lack of bio-security system program for the BSL-3 Facility leading to among others: -</p> <p>(Human Health Risks, Occupational Health and Safety Risks, Community Health and Safety Risks, Environmental Risks)</p>	<ul style="list-style-type: none"> <input type="checkbox"/> Develop laboratory biosecurity measures based on a comprehensive program of accountability for pathogens and toxins that includes an updated inventory with storage location, identification of personnel with access, description of use, documentation of internal and external transfers within and between facilities, and any inactivation and/or disposal of the materials. <input type="checkbox"/> Develop institutional laboratory biosecurity protocol for identifying, reporting, investigating and remediating breaches in laboratory biosecurity, including discrepancies in inventory results <input type="checkbox"/> Define the involvement and roles and responsibilities of public health and security authorities in the event of a security infraction. <input type="checkbox"/> Undertake laboratory biosecurity training, distinct from laboratory biosafety training to all personnel. Such training should help personnel understand the need for protection of such materials and the rationale for the specific biosecurity measures and should include a review of relevant national standards and institution specific procedures. <input type="checkbox"/> Develop procedures describing the security roles and responsibilities of personnel in the event of a security infraction should also be presented during training. <input type="checkbox"/> Develop code of conduct and professional ethical suitability among workers for working with dangerous pathogens of all personnel who have regular authorized access to sensitive materials is also central to effective laboratory biosecurity activities and should be done through an assessment of the suitability of personnel, security-specific training and rigorous adherence to pathogen protection procedures are reasonable means of enhancing laboratory biosecurity <input type="checkbox"/> Develop compliance checks with these procedures, with clear instructions on roles, responsibilities and remedial actions. <input type="checkbox"/> Undertake regular risk and threat assessments, and regular review and updating of procedures.

Environmental / Social Impact	Mitigation Measure
<p>Impacts associated with inadequate or lack of training of the BSL-3 Facility workers/personnel leading to among others: -</p> <p>(Human Health Risks, Occupational Health and Safety Risks, Community Health and Safety Risks, Environmental Risks)</p>	<ul style="list-style-type: none"> <input type="checkbox"/> Recruit qualified personnel to work in the BSL-3 facility <input type="checkbox"/> Conduct safety organization and training for the BSL-3 workers <input type="checkbox"/> Appoint a Biosafety Officer to ensure that biosafety policies and programs are followed consistently throughout the laboratory. The biosafety officer executes these duties on behalf of the head of the institute or laboratory. <input type="checkbox"/> Undertake Support Staff Safety Training for skilled engineers and craftsmen who maintain and repair the structure, facilities and equipment, should have some knowledge of the nature of the work of the laboratory, and of safety regulations and procedures. <input type="checkbox"/> Testing of equipment after servicing, e.g. testing the efficiency of biological safety cabinets after new filters have been fitted, may be carried out by or under supervision of the biosafety officer. <input type="checkbox"/> Engineering and maintenance staff should only enter the Biosafety Level 3 facility with clearance and supervision by the biosafety officer and/or the laboratory supervisor. <input type="checkbox"/> The Biosafety Level 3 facility should only be cleaned by the laboratory staff. <input type="checkbox"/> Cleaning personnel should only enter Biosafety Level 3 or Biosafety Level 4 laboratories with clearance and supervision by the biosafety officer and/or the laboratory supervisor. <input type="checkbox"/> Constitute a Biosafety Committee to develop institutional biosafety policies and codes of practice. The biosafety committee should also review research protocols for work involving infectious agents, animal use. Other functions of the committee may include risk assessments, formulation of new safety policies and arbitration in disputes over safety matters.

Environmental and Social Management Plan (ESMP)

An Environmental and Social Management Plan outlining potential environmental and social risks associated with the proposed BSL3 lab, institutional arrangement for management of risks, parties responsible for implementing and monitoring actions, associated costs, indicators and capacity building needs and reporting requirements have been prepared. Responsibilities of ZNPHI, the Project implementation unit, Biosafety Committee, Biosafety and Biosecurity Officer, Zambia Environment Management Authority and other relevant staff and stakeholders have been described. Monitoring will be undertaken by Zambia Environment Management Authority and ZNPHI. Capacity building measures have been proposed to improve the ZNPHI's ability to manage the risks associated with the project. To maintain regulatory compliance and to protect personnel, the community and the environment from biohazards, ZNPHI will be responsible for deploying pertinent staff for proper implementation of the ESMP and ICWMP. Capacity building training for ESMP implementation monitoring will be provided to relevant staff of MoH, ZNPHI, and Zambia Environment Management Authority. The proposed budget for the capacity building activities will be USD 68,000. The estimated cost for the implementation of the ESMP and environmental monitoring is USD 1,460,000.00.