Environmental and Social Impact Assessment for Vaccine Laboratory Complex

Ethiopian COVID-19 Emergency Response Project (P17375)

Proponent: The Ethiopian Minster of Heath and Ethiopian Food & Drug Authority with financial support of WBG

Submitted to: Ethiopian Environmental Protection Authority

Consulting Firm: Basal Consulting

DRAFT ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT

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EXECUTIVE SUMMARY

Ethiopia has a population of more than 105 million and is the second-most populous country in Africa after Nigeria. The government of Ethiopia has spent huge resources in the past two decades to strengthen health system and have achieved significant gains in improving the health status of Ethiopians. As a result, the numbers of multinational and national companies interested to invest in the Ethiopian market; in food and pharmaceutical sector, are increasing from time to time. Consequently, this has resulted in a tremendous increment of both the type and volume of food and medical products imported by the country. In addition, different industrial parks have identified, and constructions are under way for the local productions of foods and medical products which are expected to increase in the coming GTP phases. Comparable efforts have been underway to ensure safety and quality of both food and pharmaceutical products and quality of health services through strengthening the federal and regional regulatory bodies. However, to deal with the advance in food and pharmaceutical technology and the ever-changing challenges of substandard and counterfeit medical commodities, it requires establishment and maintaining an efficient and effective regulatory system which is staffed with competent regulators supported by training center and state of the art laboratories. Cognizant of these facts, the Ethiopian government has already allotted a 10,500 square meters plot of land for construction of the Food and Medicine regulators training and quality assurance center. At present, ensuring the safety, quality and efficacy or performance as applicable of all food, medicines, medical devices, and other supplies that are used in the health care system of a country is not adequately addressed. This is because, the existing regulatory sector lacks some of the advanced laboratory technologies and competent regulators at all levels (Federal to District level).

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)

Since the vaccine laboratory project supported by the Bank through Investment Project Financing, it is subjected to meet the Environmental and Social Standards (ESS) of the Bank requirement. The fact that the proposed Vaccine laboratory project activities would largely entail construction of new buildings within MOH title deed land, which is already owned by the MOH, it will not seek involuntary acquisition of land and involuntary resettlement issues hence will not trigger ESS5on Land Acquisition, Restrictions on Land Use and 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 laboratory waste management and proper operation of incinerators. Air emission from incineration of decontaminated wastes and effluents from the proposed Vaccine laboratory should fulfill 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.

The overall environmental and social risk rating of this vaccine laboratory complex project is substantial risk. This is because: the occupational and public health risk associated with vaccine lab; 2) the risk associated with laboratory waste incinerators; 3) the risk associated with laboratory wastewater; 4) the proposed vaccine lab has no existing waste management infrastructure.

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 preferred due to the huge social benefits that Ethiopia can harness from the development and operationalization of the proposed vaccine laboratory project.

The construction/installation of new incinerator that fulfills the national standard is the preferred option considering the waste characteristics that generated from vaccine laboratory. The incinerator will be a 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 paralleled dusting, lower contamination of filter dusts because of PCDD/PCDF destruction at the catalytic surface that have high efficiency reduction of dioxin upto <0.1 ng TEQ/m3.

Evan if requirement of effluent treatment plant incurs investment cost, working capital requirement, management requirement, utility and maintenance cost, skilled professional requirement, and the budget allocated for the project, the vaccine laboratory center needs its own wastewater treatment plant even for accreditation. Therefore, the teams of consultant recommend the MOH needs to construct new wastewater treatment plant for hazardous and nonhazardous wastes in collaboration of the government.

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 vaccine 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 Vaccine Laboratory compound sewer system could be connected. The proposed vaccine lab project will develop its own liquid waste treatment plant at premise to dispose its own sewage. The proposed vaccine laboratory will establish an appropriate liquid waste treatment and management methods. A designated waste treatment facility will be constructed in the project site, and it would be constructed according to US EPA or international standard and monitored to avoid ground water pollution. 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.

Consultation with relevant stakeholders (from community representatives, representatives of religious institution and with members of the different sector offices and participants from the EFDA and MOH) was conducted on September 20/2022. 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 vaccine laboratory building. Consultation was conducted at the Akaki Kality Sub-city, Woreda 05 Hall with participants drawn from elders, representatives of religious institution and with members of the different sector offices and participants from the EFDA and MOH.

The implementation of the project will have significant positive socio-economic and political impacts such as employment generation, income generation, and protect and promote public health by ensuring the safety and, effectiveness and quality and proper use of regulated food,

drug and medical equipment's strengthen. Implementation of the project will have also potential environmental effects anticipated to occur during construction and operation activities.

Positive benefits of the project may arise either from short-term job opportunities during construction, or long-term job opportunities during operation. The private sector will generate new incomes in terms of profits, while government sector will earn revenue in terms of direct and indirect taxes. It will have also significant positive impacts for regional integration, human resource development and technology transfer and promote public health.

Adverse impacts can be classified into three stages namely pre-construction, construction, and operation phases. The pre-construction phase will give rise to fugitive dust and vehicle exhaust emissions, soil compaction and soil structure changes, rise in noise level, clearing some plants from the project site. Land clearing activity before the construction begins has a temporary adverse impact on the ecological integrity of the land to which the project is planned to be situated. Site clearing will also cause erosion, siltation, and changes in natural water flow during summer. Other construction impacts include air pollution, Soil pollution and erosion, Noise and vibration impacts, Impacts on Landscape and Visual Receptors, Traffic and Public safety impacts, Wastewater Generation Impacts, Solid Waste Generation Impacts, Impact on plant biodiversity, Impact on Animal Biodiversity, Risk of Social Conflict and Crime, Gender based violence, Impact on traffic and public safety, and child right violation impacts and occupational health and safety Impacts.

Beyond the adverse impacts expected from the construction and pre-construction stages, the project is expected to have negative impacts during operations. This vaccine laboratory will generate considerable amounts of solid wastes both during construction and operation. So, integrated solid waste management system is recommended. The proponent needs to give priority to the reduction of the materials at source, segregation, reuse and recycle. The vaccine laboratory will use its own new wastewater treatment plan for liquid waste and new incinerator for solid waste management at the project site. The team of consultant recommended the construction of new incinerator and liquid waste treatment plant, MOH will construct the incinerator and liquid waste treatment plant within the project construction period and ensure the functionality prior to operation.

Analysis of impacts indicated that, most of the adverse impacts identified for the construction of vaccine laboratory project are determined to have a range of compatible to moderate impacts significance. Therefore, there is a need for attention at different stages of project cycle.

Concerning the views of local communities towards the project, valuable information was obtained from public consultations made with concerned stakeholders and organ bodies. Consultation with relevant stakeholders (from community representatives, representatives of religious institution and with members of the different sector offices was conducted in the following. Based on the social impact assessment, almost all residents welcome the project. To enhance the local employment and business opportunities, the mitigation measures listed in the report should be implemented.

The main mitigation and monitoring measures to minimize or reduce the environmental and social impacts especially for those with medium and severe level impacts will be implemented based on the management plans. Similarly, implementation of the mitigation measures will be verified through environmental and social monitoring plan using the specified budget. Based on these, identification of alternatives provides a basis for choice among options available for decision making.

Therefore, analysis of different alternatives indicated that, retaining the proposed establishment project site and implementation of the project with recommended mitigation measures, is assessed as the most feasible option which will balance the project benefits and adverse impacts. The study team recommends that the project proponent should oversee implementation of mitigation measures at each stage of project cycle to avoid, minimize and offset those impacts which are identified in this report as well as immediately report and prepare management plan for any unforeseen impacts. The Project Coordination Team, under Engineering Service Directorate (ESD) of MoH and EFDA, will have institutional responsibility of implementing the ESMP at the highest level.

Capacity building training for ESMP implementation monitoring will be provided to relevant staff of EFDA and BoLSA to enhance their skills in environmental monitoring during the operational phases of the Laboratory. The overall budget cost required for the implementation of the indicative ESMP and its monitoring plan and all the capacity building activities are 770,775.00 USD.

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ABBREVIATIONS AND DEFINITIONS

AAWSSA	Addis Ababa Water Supply and Sewerage Authority
BMBL	Biosafety in Microbiological and Biomedical Laboratories
CDC	Centre for Diseases Prevention and Control
EFDA	Ethiopian Food and Drug Authority
EHS	Environment, health and safety
EIA	Environmental Impact Assessment
EPA	Environmental Protection Agency
ESA	Environmental and Social Audit
ESCP	Environmental and Social Commitment Plan
ESIA	Environmental and Social Impact Assessment
ESIRT	Environment and Social Incidence Response Toolkit
ESMP	Environmental and Social Management Plan
ESMS	Environmental and Social Management System
ESS	Environmental and Social Standards
MOH	Minister of Health
FDRE	Federal Democratic Republic of Ethiopia
EFDA	Ethiopian Food and Drug Authority
GRM	Grievance Redress Mechanism
HCWM	Health Care Waste Management
ICWMP	Infection Control and Waste Management Plan
PCT	Project Coordination Team
ESD	Engineering Service Directorate
PPE	Personal Protection Equipment
RCA	Root Cause Analysis
SEP	Stakeholder Engagement Plan
WB	World Bank
WHO	World Health Organization

1. INTRODUCTION

1.1 Project Background

The Government of Ethiopia has made remarkable progress in ensuring access to primary healthcare as well as achieving most of the MDGs targets. There has been a rapid growth of health facilities and services both in the public & private sector. Currently, the country is the second largest populated country in Africa, next to Nigeria with promising economic growth. As a result, the numbers of multinational and national companies interested to invest in the Ethiopian market; in food and pharmaceutical sector, are increasing from time to time. Consequently, this has resulted in a tremendous increment of both the type and volume of food and medical products imported by the country.

In addition, different industrial parks have identified, and constructions are under way for the local productions of foods and medical products which are expected to increase in the coming GTP phases. Comparable efforts have been underway to ensure safety and quality of both food & pharmaceutical products and quality of health services through strengthening the federal and regional regulatory bodies. However, to deal with the advance in food and pharmaceutical technology and the ever-changing challenges of substandard and counterfeit medical commodities, it requires establishment and maintaining an efficient and effective regulatory system which is staffed with competent regulators supported by training center and state of the art laboratories. Cognizant of these facts, the Ethiopian government has already allotted a 10,500 square meters plot of land for construction of the Food & Medicine regulators training and quality assurance center. At present, ensuring the safety, quality and efficacy or performance as applicable of all food, medicines, medical devices, and other supplies that are used in the health care system of a country is not adequately addressed. This is because, the existing regulatory sector lacks some of the advanced laboratory technologies and competent regulators at all levels (Federal to District level).

On the other hand, collaboration, and harmonization of regulatory functions at sub regional, regional and international level has become one of the areas that need special attention. Therefore, the purpose of the new vaccine laboratory building for regulators training and quality assurance will be to support local food & pharmaceuticals manufacturing industries and enable the country and regulatory authorities in the region to cope with the dramatic changes in pharmaceutical technologies and control of SSFFCs and modernize the regulatory practices in the

region. The project shall cover the efficient plot utilization plan with future expansion, buildings plan & design of the Center. The project site of approximately 10,500 square meters area is located at Akaki-Kality Sub-city at about 10 kilometers from the current EFDA office. The plans and designs shall be in accordance with basic requirements in this Terms of Reference. The site utilization shall be developed to accommodate the standard requirements for a Research laboratory, Quality control laboratories, training centers and Ancillary Service areas.

The vaccine laboratory building is implemented under the Ethiopia COVID-19 Emergency response project (P173750) which was approved on April 2, 2020. The actions supported by Ethiopian Covid-19 Emergency Response Projects are organized under five components: (i) Medical Supplies and Equipment; (ii) Preparedness, Capacity Building and Training; (iii) Community Discussion and Information Outreach; (iv) Quarantine, Isolation and Treatment Centers; and (v) a Project Implementation and Monitoring.

Under component of Quarantine, Isolation and Treatment Centers, one of the activities to be financed by the Project is the vaccine laboratory renovation and equipping and during the project endorsement, an environmental and social management framework (ESMF) was prepared based on the World Bank's environmental and social safeguard policies for this project. Despite the economic positive impact, vaccine laboratory complex construction development project will have negatively impact on the environment and societies in several ways during construction, operation and decommissioning phases of their project life cycles. Therefore, this Environmental and social Impact Assessment report (ESIA) seeks to assess both the significant positive and negative impact that the proposed vaccine laboratory complex development project is likely to have on both the physical and socio-economic environment and the mitigation measures to be taken in order for sound decision making.

The Environmental and social consideration should start early-on and the layout plan of the buildings should be guided by environmental and climatic factors, and alternative layouts will be compared on environmental and climatic grounds. The design of the building should incorporate environmental concepts such as avoiding/minimizing adverse environmental impacts, recycling, or reusing and proper handling of laboratory & other wastes, making optimal use of natural systems (such as solar energy and natural lights), health & safety as well as accident/emergency management measures, contributing to positive environmental aspects (such as recharging groundwater) etc. The proposed layout and designs should be screened for any environmental risks. The consultant shall carry out environmental assessment to predict damages of the building

construction to the Environment and attempt first to avoid and then to minimize the risks or damage through appropriate lay-out and design features. The possible management mechanisms for unavoidable risks should be provided, such as mitigation through appropriate mitigation measures (appropriate technology, type of structures, management, etc.). The consultant will suggest appropriate measures in the design for protection of surrounding environment. Environmental and Social Management Framework for Implementation of Building Resilience to Climate Related Hazards as well as the Government of Ethiopia environmental policies, Environmental Protection proclamation and Environmental Protections Rules should be followed.

1.2. Objectives of the ESIA

1.2.1. General Objectives of ESIA

The overall objective of the ESIA is to identify, analyze and evaluate both the negative and positive impacts that can arise during the construction, operation and decommission of Vaccine laboratory complex and propose the possible mitigation measures.

1.2.2. Specific Objectives of ESIA

Specifically, this ESIA study was conducted to:

- Assess the baseline condition of the environment and nature of the project.
- Identify, analyze, and evaluate the significant impacts associated with project activities,
- Verify compliance with environmental laws, policies and regulations as well as best practice and standards.
- Identify and analyze alternatives to the proposed project.
- Identify, analyze, and propose mitigation measures for negative anticipated impacts and enhancement measures for positive anticipated impacts,
- Prepare an Environmental management and monitoring plan

1.3. Methodology

This section describes the broad principles and methodological steps of the ESIA indicating the techniques applied for impact identification, quantification, analysis, and mitigation. The Environmental and Social Impact Assessment (ESIA) process incorporates several Key steps. The assessment process constitutes a systematic approach to the evaluation of a project in the context of the natural, regulatory, and socio-economic environments of the area in which the

project is proposed to be implemented. The process adopted to undertake the ESIA study for the Vaccine Laboratory project is discussed below.

1.3.1 Environment and Social Screening

Environmental and Social screening of sub-projects is carried at the initial stages of the ESIA process to determine the level of assessment that need to be carried on the sub - project. Though the type of projects falling into the different categories are essentially similar, the national environmental screening system follows a different approach from the World Bank by adopting a list of scheduled projects grouped in different categories. The environmental and social screening system as it applies for the vaccine lab project is described as follows.

1.3.1.1.Classification According to Ethiopian EIA Procedural Guideline

The Environmental Impact Assessment Proclamation (No 299/2002) aims primarily at making the EIA mandatory for categories of projects specified under a directive issued by the former Ministry of Environment, Forest, and Climate Change. The EIA procedural guideline published by the EPA in 2003 have outlined the categories of development projects and activities that will require full, partial and no environmental impact assessment (EIA). Under schedule II activities of the EIA guideline the type of Activities that are required to conduct Preliminary Environmental Impact Assessment study report are listed. One of the activities identified under it is *"Hospitals and Dispensaries"*. As such the proposed vaccine lab project is not directly included in the list of scheduled activities; however, apparently it is an important part of health facilities. It is prudent to consider the proposed vaccine lab development project as schedule II activities listed under the section. Thus,it falls in schedule II projects and hence requires ESIA. To fulfill its requirements under the national EIA law, the project proponent (EFDA/MOH) will have to conduct and submit a preliminary environmental impact assessment study for the development project. This ESIA report is prepared towards fulfilling the national EIA requirement and will be submitted to the competent authority. In this regard, the Addis Ababa EPA is the responsible body for review and approval of the final ESIA document.

1.3.1.2.Classification according to World Bank

The World Bank classifies a proposed project into one of four categories based on the World Bank environmental and social framework (ESF). These classifications are High Risk, Substantial Risk, Moderate Risk or Low Risk. The determination of appropriate risk

classification of a proposed project depends various factors, the main considering factors during classification are:

1. The type, location, sensitivity, and scale of the project. In this case, physical considerations, type of infrastructure (e.g., dams & reservoirs, power plants, airports, roads), volume of hazardous waste and disposal would be under consideration.
2. The nature and magnitude of the potential environmental and social risks and impactsand available mitigation measures. Mainly, impacts on greenfield sites and brownfield sites (e.g., rehabilitation, maintenance or upgrading), nature of potential risks and impacts (e.g. irreversible, unprecedented or complex), resettlement activities, Indigenous Peoples presence and the possible mitigation measures under the mitigation hierarchy considered.
3. The capacity and commitment of the Borrower (including any other entity responsible for the implementation of the project) to manage the environmental and social risks and capacity to manage risks and impacts consistent with the ESSs. It includes the country policy, legal and institutional framework, laws, regulations, rules, and procedures, applicable to the project sector, regional and local requirements, technical and institutional capacity, track record of past project implementation, and the availability of financial and human resources.
4. Context risk relevant to environmental and social measures. The context risk covers the other areas of riskrelevant to the delivery of environmental and social mitigation measures and outcomes, depending on the specific project and the context in which it is being developed, including the nature of the mitigation and technology being proposed. It is also considered domestic and/or regional stability, conflict, or security.

1.3.2 Environmental and social scoping

The scope was established by the ToR. Principally, at this phase project activities having potentially significant impact on the natural and/or socioeconomic environment would be established for the rest of the ESIA process.

1.3.3 Primary and Secondary Data Collection

Environmental and socio-economic data was assessed in greater detail to ensure all the proposed project activities and their consequences were considered in all stages of the development.

To identify any potential impact and potential change to the natural and socio- economic environments, it was essential to have a thorough understanding of the existing environment prior to commencement of the proposed activities.

In this regard there was a need to characterize the existing baseline environmental and socioeconomic conditions including establishing the prevailing conditions for a range of media as follows: Natural environment media such as water, air, soil and groundwater, flora and fauna; Socio-economic media such as demographics, economic activity and service provisions. Primary and secondary data are collected by conducting desktop studies, literature reviews, field surveys with physical observation and questionnaires and stakeholder consultations.

- **Literature review**: Information on existing environmental conditions was obtained from review of various published and unpublished sources. In addition, review of the relevant healthcare waste management literature, World Bank Safeguard Policies, ESMF and various guidelines including the IFC EHS guidelines were also made. The review also examined technical and supervision documents from previous and ongoing World Bank project and programs in the health sector, namely the Protection of Basis Services Program and Nutrition Project.
- **Competent authority guidelines**: The Federal and regional legislative and institutional framework, policies, procedures, and guidelines for environmental management has been reviewed. In addition, the review examined the set of national policy and legal requirements related to environment and social management in the health sector. Sociological and environmental data was also gathered by consulting and discussing with the experts in concerned stakeholder government agencies.

- **Field Surveys:** The method of field surveying is useful for identifying the likely impacts of a given development project on the environment around the project site. The team has been mobilized for field survey to the project site. Site visit was carried out in the area for construction of Vaccine Laboratory. The aim of the site visit was to assess baseline conditions and how environmental and social management issues are managed. Consultations with EFDA and MOH officials provided additional data to inform the ESIA on institutional capacity for applying the ESMP at EFDA levels. The team conducted observations in and around the project site and its external surrounding area to gather essential field data. During site observation information on physical, biological, and

socio-economic environment has been collected. In addition, base line data collection was also done through site investigations.

- **Interviews with specialists**: Project alternatives, designs and processes were discussed with the project engineers with particular emphasis on the reasons establishing the form and scope of the proposed project. Proposed layout of the Vaccine laboratory, EFDA Campus Master Plan and engineering design criteria documents produced by Black & Veatech Special Project Core responsible for the detail designing of the Vaccine lab project were consulted to define the main components of the project in developing the project description chapter.

1.3.4 Stakeholder engagement and community consultation

Project stakeholder consultation is important component of the ESIA process. The consultation process focused on providing information on the proposed Vaccine Laboratory development project in a manner that can be understood and interpreted by the relevant audience, seeking comment on key issues and concerns, identifying potential impacts, and offering the opportunity for alternatives or objections to be raised by the potentially affected parties and other stakeholders.

All relevant stakeholders were identified and consultations at all levels of the ESIA study were conducted. By conducting the consultations, the people that will be affected by or have an interest in the proposed project were having an opportunity to express their opinions and concerns.

- **Stakeholder consultation:** Information regarding to the project was provided to stakeholders to enable them to understand project risks, impacts and opportunities. The stakeholder consultation aim was to create understanding of the project, understand local expectations of the project, and identify potential environmental and socio-economic impacts as well as to gather consensus on mitigation options. Interviews and consultation discussions were held with various government representatives and authorities, including those at the national and EFDA levels as well as technical experts involved with environmental and social impact assessment and management in the health sector. Specifically, formal interviews were conducted with relevant personnel in the EFDA and MOH, experts in the Ministry of Urban Development and Construction; and experts in the Addis Ababa Bureau of Labor and Social Affairs. Inaddition, interviews were held

with EFDA staff to assess strengths and gaps in effectively managing environmental and social effects in the sector at the regional and local level. The minutes of meeting outlining the issues raised and discussed are attached in Annex I.

- **Community consultation**: Community participation and consultation is an important step in the ESIA methodological process. Public consultation is instrumental in assessing the socio-economic impacts of the project. Community consultation meetings have been convened to draw together the issues and concerns of the resident communities found in the neighborhood of the project site. Participants of the community consultation included community members, elders, women, youth and other residents in the area (See Annex I).

Figure 1: Showing the community & Stakeholder consultation meeting

1.3.5 Identification and analysis of the environmental impacts

Potentially beneficial as well as adverse impacts on the biophysical and socio-economic environment associated with the construction, operation and decommissioning phases of the proposed Vaccine Laboratory project were identified with the help of checklists, site survey,

observation, overlay, experience, literatures, and consultations with stakeholders and affected parties. Moreover, environmental impact analyses were carried out in three stages:

- **Identification:** this includes description of the existing environment, determination of the project components and definition of the environment that will be modified by the project
- **Prediction:** forecasting of the quality and/or spatial dimensions of the changes and estimation of the probability that the impact will occur.
- **Evaluation:** Determination of the incidence, magnitude and significance of the impact.

The predicted environmental and social impacts took the following parameters into consideration:

- **Nature of Impact:** Direct, indirect or cumulative;
- **Type of impact:** Positive, negative or both;
- **Duration of impact:** Short term, medium term or long term;
- **Spatial scale of impact:** Localized, or widespread
- **Extent of baseline change:** Low, medium or high

Each impact is evaluated using the criteria listed in Table 1. To provide a relative illustration of impact severity, it is useful to assign numerical or relative descriptors to the impact intensity and receptor sensitivity for each potential impact. Each is assigned a numerical descriptor of 1, 2, 3, or 4, equivalent to very low, low, medium or high. The severity of impact was then indicated by the product of the two numerical descriptors, with severity being described as negligible, minor, moderate or major. This is a qualitative method designed to provide a broad ranking of the different impacts of a project. Illustrations of the types of impact that were assigned the different grades of severity are given in Table 1.

Table 1: Impact Description

S.N	Classification	Description
1	Extent	Evaluation of the area of occurrence/influence by the impact on the subject environment; whether the impact will occur on site, within 2km radius of the site; locally (within 5 km radius of the site); regionally (district wide, nationally or internationally).
2	Persistence/Duration:	Evaluation of the duration of impact o Temporary (<1 year); o short term (1 – 5 years);

		○ medium term (5 – 10 years); ○ long term (>10); or permanent.
3	Social Context / Sensitivity or Potential for Stakeholder Conflict:	Assessment of the impacts for sensitive receptors in terms of ecological, social sensitivity and such things as rare and endangered species, unusual and vulnerable environments, architecture, social or cultural setting, major potential for stakeholder conflicts. The sensitivity classification is shown below: **High sensitivity:** Entire community displacement, destruction of world heritage and important cultural sites, large scale stakeholder conflict, etc. **Medium sensitivity:** Displacement of some households, moderate level of stakeholder concern **Low sensitivity:** No displacements, no potential for stakeholder conflict.
4	Regulatory and Legal Compliance:	Evaluation of the impact against Local and International legislative requirements. **High**: Prohibition terms for specific activities/emissions. Major breach of regulatory requirements resulting in potential prosecution or significant project approval delays. **Medium**: Potential breach of specific regulatory consent limits resulting in non-compliance. **Low**: No breach of specific regulatory consent limits anticipated.
5	Overall Impact rating (Severity):	Using a combination of the above criteria, the overall severity of the impact was assigned a rating Severe**, Substantial, Moderate, Minor** and negligible. **Note:** These are just guidelines that will constitute professional judgment required in each individual case.

Impact significance is determined from an impact significance matrix (Table 2) which compares severity of the impact with probability of its occurrence. Impact significance criteria are as follows:

• **Very High (VH) and High (H):** These denote that the impact is unacceptable and further mitigation measures must be implemented to reduce the significance (Shaded red in Table 2)

• **Medium (M):** Impacts in this region are considered tolerable but efforts must be made to reduce the impact to levels that are as low as reasonably practical (Shaded orange in the impact significance matrix)

• **Very Low (VL) and Low (L):** Impacts in this region are considered acceptable. Shaded yellow in the impact significance matrix.

Table 2: Impact significance matrices

Receptor Sensitivity		**Very low 1**	**Low 2**	**Medium 3**	**High 4**
Intensity of impact	Very low 1	1 Negligible	2 Minor	3 Minor	4 Minor
	Low 2	2 Minor	4 Minor	6 Moderate	8 Moderate
	Medium 3	3 Minor	6 Moderate	9 Moderate	12 Major
	High 4	4 Minor	8 Moderate	12 Major	16 Major

* Severity of Impact is the product of receptor sensitivity and intensity of impact

Finally, the magnitude and significance level of the identified impacts will be judged as major, high, medium or low significance impacts.

1. **Environmental Mitigation and Benefit Enhancing Measures:**

Based on the impact assessment feasible and cost-effective mitigating and benefit enhancement measures that may reduce potentially significant adverse environmental impacts to acceptable levels were recommended under this step.

2. **Environmental Management and Monitoring Plan:**

It will be necessary to monitor and audit project development and operation. Monitoring will provide the information necessary for feedback into the environmental management process and will assist in identifying where additional mitigation effort or where alteration to the adopted management approach may be required. The monitoring plan describes the various environmental management strategies and generic procedures for their implementation. Further, it identifies the management roles and responsibilities for ensuring that monitoring is undertaken and that the results are analyzed and any necessary amendments are identified and implemented in a timely manner.

2. LEGAL, INSTITUTIONAL AND POLICY FRAMEWORK OF THE ESIA OF THE PROJECT

This section describes the legal and regulatory requirements for environmental impact assessment and management in Ethiopia. Development projects in Ethiopia are required to meet and fulfill relevant legal provisions and policy frameworks that are intended to protect the environment and health of the society in general. The relevant national legislations and policy frameworks as well as the World Bank safeguard operational policies are reviewed and presented as follows.

2.1.Constitution and Relevant Policies in Ethiopia

2.1.1. Constitution

The constitution of the Federal Democratic Republic of Ethiopia (FDRE) provides the overriding principles for all legislative frameworks in the country. The concept of sustainable development and the environmental rights of the people are protected in the constitution by the articles that stipulate the rights of peoples in the country. The concept of sustainable development and environmental rights are enshrined in article 43, 44 and 92 of the Constitution of FDRE.

- **Article 43.** The Right to Development identifies citizens' right to improved living standards and sustainable development and participates in national development and to be consulted with respect to policies and projects affecting their community.
- **Article 44.** Environmental Rights stipulations that all citizens have the right to a clean and healthy environment; and those who have been displaced or whose livelihoods have been adversely affected as a result of state programs have a right to commensurate monetary or alternative means of compensation, including relocation with adequate state assistance.
- **Article 92.** Environmental objectives are identified as government shall endeavour to ensure that all Ethiopians live in a clean and healthy environment. The design and implementation of programs shall not damage nor destroy the environment. Citizens also have a right to full consultation and to expression of views in the planning and implementation of environmental policies and projects that directly affect them. Government and citizens shall have the duty to protect the environment.
- **The National Conservation Strategy** (1995) takes a holistic view of natural and cultural resources and seeks to present a coherent framework of plans, policies, and investments related to environmental sustainability. The Strategy consists of five volumes: Natural

Resource Base, Policy and Strategy, Institutional Framework, Action Plan, and Compilation of Investment Program.

2.2. Environmental Policy of Ethiopia

The Environmental Policy of Ethiopia was approved by the Council of Ministers in 1997. It is comprised of 10 sector and 10 cross-sector components, one of which addresses Human Settlements, Urban Environment and Environmental Health. The Policy is based on the findings and recommendations of the National Conservation Strategy of Ethiopia. The Policy contains elements that emphasize the importance of mainstreaming socio-ecological dimensions in development programs and projects. The goal of the Environmental Policy of Ethiopia is to improve and enhance the health and quality of life of all Ethiopians and to promote sustainable social and economic development through sound management of the environment and use of resources so as to meet the needs of the present generation without compromising the ability of future generations to meet their own needs. The Environmental Policy provides a number of guiding principles that require adherence to the general principles of sustainable development. In particular, the need to ensure that Environmental Impact Assessment (EIA) completes the following:

- Considers impacts on human and natural environments,
- Provides for early consideration of environmental impacts in project and program design,
- Recognizes public consultation processes as essential to effective management,
- Includes mitigation and contingency plans,
- Provides for auditing and monitoring,
- Is a legally binding requirement.

2.3. Environmental Proclamations

Proclamation 299/2002, Environmental Impact Assessment makes EIAs mandatory for implementation of major development projects, programs, and plans. The Proclamation is a tool for harmonizing and integrating environmental, economic, cultural, and social considerations into decision-making processes in a manner that promotes sustainable development. The proclamation clearly defines:

- Why there is a need to prepare EIAs,
- What procedure is to be followed in order to implement EIA
- The depth of environmental impact studies,

- Which projects require full EIA reports,
- Which projects need partial or no EIA report,
- To whom the report must be submitted.

Proclamation 300/2002, Environmental Pollution Control requires developmental activities to consider environmental impacts before their establishment. The proclamation requires ongoing activities to implement measures that reduce the degree of pollution to a set limit or quality standard. Thus, one of the dictates of the proclamation is to ensure, through inspection, the compliance of ongoing activities with the standards and regulations of the country through an environmental audit.

Proclamation 513/2007, Solid Waste Management aims to promote community participation to prevent adverse impacts and enhance benefits resulting from solid waste management. It provides for preparation of solid waste management action plans by urban local governments.

Proclamation 295/2002, Establishment of Environmental Protection Organs establishes the organizational requirements and identifies the need to establish a system that enables coordinated but differentiated responsibilities of environmental protection agencies at federal and regional levels. The proclamation indicates duties of different administrative levels responsible for applying federal law.

EIA Directive 1/ 2008, Directive to Determine Projects Subject to Environmental Impact Assessment was issued to determine the categories of projects subject to the EIA Proclamation 299/ 2002. To this end, the EIA Proclamation is to be applied to the types of projects listed under these directives. The types of projects subject to EIA in the health sector are the construction of hospitals, which are part of the HSDP IV investment menu but are not included in the menu of ACRIFP - supported activities.

Ethiopian Water Resources Management Proclamation, No. 197/2000: The proclamation is decreed to ensure that the water resources of the country are protected and utilized for the highest social and economic benefits of the people of Ethiopia, to follow up and supervise that they are duly conserved, ensure that harmful effects of water are prevented, and that the management of water resources is carried out properly. It proclaims that all water resources of the country are the common property of the Ethiopian people and the state. It has provisions on general principles of water use and management, inventory of water resources, professional engagement in water resource managementand supply. Among other articles, the proclamation clearly indicates

requirements on water bank management and prevention of harmful effects on water resources in the articles 24 and 25 of the proclamation. The supervising body (the Ministry Water, Irrigation and Energy), in collaboration and in consultation with the appropriate public body may:

- Delimit the boundaries of the banks of certain water bodies;
- Prohibit clearing and cutting trees or vegetation and construction of residential houses within the delimited banks of water bodies;
- The appropriate public bodies shall, before allowing or causing the founding of towns or villages, request the supervising body for technical advice in order to prevent or avoid damages, adverse impacts or accidents which may occur as a result of floods and other factors related to water.

Labor Proclamation 377/2003: The Labor Proclamation (which was revised in 2003) provides the basic principles which govern labor conditions considering the political, economic and social policies of the Government, and in conformity with the international conventions and treaties to which Ethiopia is a party. The proclamation under its Part Seven, Chapter One, and Article 92 of this proclamation deals with occupational safety, health and working environment, prevention measures and obligations of the employers. Accordingly, the Proclamation obliges the employer to take the necessary measure for adequate safeguarding of the workers in terms of their health and safety. Moreover, the Occupation Health and Safety Directive (MOLSA, 2003) provides the limits for occupational exposure to working conditions that have adverse impacts on health and safety.

2.4. Environmental Guidelines

2.4.1. Environmental Impact Assessment Guideline, May 2000

The guideline provides the policy and legislative framework, the general ESIA process and key sectoral environmental issues, standards and recommendations for environmental management in key sectors such as agriculture, industry, transport, tannery, dams and reservoirs, mining, textiles, irrigation, hydropower and resettlement projects.

2.4.2. Environmental and Social Management Plan Preparation Guideline, Nov. 2004

The guideline provides the essential components to be covered in any environmental management plan (e.g., identified impacts, mitigation measures, monitoring, capacity building, etc.) Similar guidelines for the different sectors include the following:

- Environmental and Social Impact Assessment Guidelines for Dams and Reservoirs, 2004
- Environmental Impact Assessment Guideline for Fertilizer, 2004
- Guidelines for Social, Environmental and Ecological Impact Assessment and
- Environmental Hygiene in Settlement Areas, 2004

2.4.3. Directive Issued to Determine Projects Subject to Environmental Impact Assessment, Directive No.1/ 2008

The directive was issued to identify and list out those investment projects subject to mandatory Environmental Impact Assessment. The regions are entitled to issue similar directive to their own specific cases based on this directive. Extensive list of project types requiring ESIA are provided in this directive.

2.4.4. Guideline for Environmental Management Plan (draft), May 2004

It outlines measures for preparation of an Environmental Management Plans for proposed developments in Ethiopia and institutional arrangements for implementation of Environmental Management Plans.

2.4.5. EIA Procedural Guideline (draft), November 2003

This guideline outlines the screening, review, and approval process for development projects in Ethiopia and defines the criteria for undertaking an EIA.

2.4.6. Waste Handling and Disposal Guideline, 1997

The Waste Handling and Disposal Guidelines have been in use by health facilities since 1997. The Guidelines are meant to help industry and local authorities handle medical waste situation at the local level.

2.5. Sectorial Legal Proclamations and Plans

2.5.1. Labor Proclamation No. 1156/2019

This proclamation obliges an employer to take the necessary measures to adequately safeguard the health and safety of the workers. It also requires employers ensure workers safety and job security. This proclamation stipulates:

Freedom of association and collective bargaining: the right of all workers to form and join trade unions and bargain collectively and recognition of this bargain. Worker's representative

shall not be subject of discrimination and shall have access to all work places necessary to enable them to carry out their representative roles.

Equality of treatment: Workers shall have access to jobs and trainings on equal terms, irrespective of gender, age, ethnic origin, color, marital status, sexual orientation, political opinion, religion and social origins. Physical harassment or psychological oppression, particularly of women workers, must not be tolerated.

Living wages: wages and benefits paid for a standard working week shall meet at least legal or industry minimum standards and always be sufficient to meet basic needs of workers and their families and to provide some discretionary income. Pay should be in cash, direct to the workers, promptly and in full. Information to wages shall be available to the workers in an understandable and detailed form.

2.5.2. Ethiopian Building Proclamation No. 624/2009

This proclamation, under sub article 53, prohibits use of improper materials or defective workmanship in construction. It states:

1. Any registered contractor or sub-contractor who is issued with a work permit by the relevant authority
    a. Performs a construction work with a low quality or below standard material in contravention of the standard set or the accepted practice for such type of construction; or
    b. Performs a construction work which causes damage as a result of his failure to rectify the errors on the design or other contract documents which were easily detectable by a professional of his kind; is punishable with rigorous imprisonment from five years up to ten years and a fine from fifty thousand to hundred thousand birr.
2. Any owner of a building who
    a. Causes the drawing up of the design or the construction work of such construction by a person who is neither qualified nor authorized to perform such works; or
    b. Makes use of low-quality materials which are not acceptable for the type of construction in question; or
    c. Puts his building into a service to which an occupancy permit is not obtained or to a service other than to which a permit is obtained from the relevant body, or

d. Constructs or causes the construction of his building in any other manner which endangers public safety severely is punishable.

3. Facilities for Physically Impaired Persons
    a. Any public building shall have a means of access suitable for use by physically impaired persons, including those who are obliged to use wheelchairs and those who are able to walk but unable to negotiate steps.
    b. Where toilet facilities are required in any building, as adequate number of such facilities shall be made suitable for use by physically impaired persons and shall be assessable to them.

2.5.3. FDRE Ten Years Development Plan - A Pathway to Prosperity (2021 – 2030) (TYDPP)

The government of Ethiopia has developed a ten-year development plan from 2021 -2030 plan by analyzing points of strength and weakness in different socio-economic sectors and put forward sectors where more strength is required. One of such sectors is the health sector.

In TYDPP the health sector was identified as one of the Deficient and low-quality provisions of social services and basic infrastructures. It further stated that "there were also wide gaps in terms of quality infrastructure provisions. Deficiencies have also been observed in social service provisions, particularly in health and education. Moreover, evidence indicate that the accessibility of social services was very low, and wide gaps in equitable distribution of basic services were observed between urban and rural areas. This has affected attempts to create equal opportunity for all citizens". The health sector has been considered in the National Development Vision, Objectives and Strategic Pillars. TYDPP put forward that environmental protection as one of the important variables necessary for realizing the planned economic Growth and development.
To this extent, proponents are required to align themselves with this economic development plan by protecting the environment from pollution.

2.6. Health Sector-Specific Policies, Laws, and Guidelines

The **Ethiopian Health Sector Policy** emphasizes promotion of occupational health and safety and environmental health.

2.6.1. Proclamation 200/2000, Public Health Proclamation

Public Health Proclamation comprehensively addresses aspects of public health including among others, water quality control, waste handling and disposal, availability of toilet facilities, and the health permit and registration of different operations. The Proclamation prohibits the disposal of untreated solid or liquid hazardous wastes into water bodies or the environment that can affect human health.

2.6.2. Proclamation 189/2010, Ethiopian Food, Medicine and Health Care Administration (FMHACA) and Control Authority Establishment Council of Ministers

It gives FMHACA the mandate to protect consumer health by ensuring the standard of health institutions and the hygiene and environmental health protection requirements for communities.

2.6.3. Proclamation 661/2009, Food, Medicine and Health Care Administration and Control

It provides provisions to:

- Ensure proper disposal of expired medicine and foods and raw materials,
- Ensure handling and disposal of trans-regional solid and liquid wastes from different institutions are not harmful to public health,
- Ensure the quality of trans-regional water supply for the public is up to the standard,
- Ensure availability of necessary hygienic requirements in public health institutions,
- Ensure any waste generated from health or research institutions is handled with special care and disposed of according to procedures that meet national standards,
- Ensure that untreated waste generated from septic tanks, seepage pits, and industries is not discharged into the environment, water bodies or water convergences.

2.6.4. National Health Care Waste Management (HCWM) Strategic Action Plan 2015/16-2019/20

It focuses on thematic areas:

- Legal and regulatory framework to provide guidance to health care managers on minimum operation requirements and the need to standardize HCWM practices in all healthcare facilities in the country.
- Process of operational research in pollution reduction and adoption of environmentally friendly technologies.
- Conduct behavioral changes targeting patients, care givers, visitors, and the community in the vicinity of health facilities.

2.6.5. Health and Safety Guidelines for Public Health Laboratories in Ethiopia, 2010

It provides guidance on laboratory waste disinfectant, handling, and disposal and to serve as a helpful reference and guide for all public health laboratories in the country.

2.6.6. National Hygiene and Sanitation Strategic Action Plan 2015/16-2019/20

This Plan focuses scale up community led, and school led total sanitation and hygiene and sanitation marketing, build adaptation and resilience to climate change in health sector. A separate national strategy is under development to address large-scale and communal off-site sanitation needs in urban areas in Ethiopia.

2.6.7. Medicinal Waste Management and Disposal Directive, 2011

It is applicable to (a) disposal of medicinal waste, but not to medical equipment or management of other healthcare waste generatedby health institutions; and (b) all government, and nongovernmental and private organizations involved in medicinal waste handling and disposal. The Directive requires disposal firms to have secured an appropriate disposal site depending on the Environmental Impact Assessment conducted with support of the Federal Environmental Protection Authority. In addition, a disposal firm is required to have all the facility and practice standards prescribed under this Directive.

2.6.8. The Guideline for Waste Handling and Disposal in Health Facilities (2006)

It was developed to:

- Enable health professionals to protect themselves against health hazards which might be encountered as result of their occupational
- Create awareness among healthcare workers about the importance of safe disposal of waste generated at health facilities
- Prevent and control environmental pollution by waste carelessly disposed of from health facilities.
- Provide technical support to health professionals and environmental health workers engaged in day-to-day health inspection and control activities.

The National health care waste guideline outlines the categorization of health care wastes, the details of principles, procedures and actions that should be followed in managing the health care wastes on a daily basis, suggest safe collection, storage and transportation mechanisms for both within and out of the health care facilities, suggest the type of waste treatment options for both

solid and liquid (infectious & hazardous) wastes including incineration options, recommend minimum health care waste management options/standards for different health care facilities and provide guidelines for monitoring systems and reporting procedures for HCWM at all levels.

2.7. International Conventions Ratified by Ethiopia

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. Some of these conventions include the following:

- Convention on Access to Information, Public Participation in Decision-making and Access to Justice in Environmental Matters, Done at Aarhus, Denmark, On 25 June 1998
- Cartagena Protocol on Bio-Safety to the Convention on Biological Diversity Convention on Biological Diversity, Rio, 5 June 1992
- Convention for the Protection of the World Cultural and Natural Heritage Paris, 23 November 1972.
- International Labour Organization (ILO) Forced Labour Convention, 1930 (No. 29)
- ILO Equal Remuneration Convention, 1951 (No. 100)

Ethiopia is party to four international conventions, which directly or indirectly deal with pesticides production and use. These include:

- Persistent Organic Pollutants of Stockholm Convention, which tries to completely eliminate organo-chlorine and other equally dangerous organo-halogen chemicals from the earth.
- Bamako Convention, which prohibits the importation of hazardous wastes into, and theirmovement in, Africa.
- Basel Convention, which strictly regulates the movement of hazardous waste globally. Recently, it has incorporated the prohibition of the importation of hazardous wastes into developing countries from the Bamako Convention.
- The first Prior Informed Consent or Rotterdam Convention, which tries to ensure that anybody buying a chemical has complete and accurate information about the nature and impacts of that chemical before he/she decides and notifies his/her consent in writing to the exporter.

Because Ethiopia ratified Stockholm Convention and Basel Convention, 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.

2.8. Relevant International Guidelines

2.8.1 World Health Organization Guidance

The WHO policy paper, Safe health-care waste management (WHO, 2004), recommends that countries conduct assessments before choosing health-care management methods. WHO guidance on implementing regulatory requirements for biosafety and biosecurity in biomedical laboratories demonstrates Stepwise approach to regulating laboratory biosafety and biosecurity. Failure to comply with this safety requirement may result in hazard to health workers and the community. Accordingly, retraining the employees about the operation and utilization of the lab is required.

WHO suggests that government organizations adopt the strategies outlined below:

i. Short-term strategies

- Production of all syringe components using the same plastic to facilitate recycling.
- Selection of polyvinyl chloride–free medical devices.
- Identification and development of recycling options wherever possible (e.g. for plastic, glass).
- Research into, and promotion of, new technology or alternative to small-scale incineration.

Until countries in transition and developing countries have access to health-care waste-management options that are safer for the environment and health, regional laboratory may be an acceptable response when used appropriately. Key elements of appropriate operation of incinerators include effective waste reduction and waste segregation, placing incinerators away from populated areas, satisfactorily engineered design, construction following appropriate dimensional plans, proper operation, periodic maintenance, and staff training and management.

ii. Medium-term strategies

- Further efforts to reduce the number of unnecessary injections, to reduce the amount of hazardous health-care waste that needs to be treated.

- Research into the health effects of chronic exposure to low levels of dioxin and furan.
- Risk assessment to compare the health risks associated with (a) incineration, and (b) exposure to health-care waste.

iii. Long-term strategies

- Effective prevention of disease burden from (a) unsafe health-care waste management, and (b) exposure to dioxins and furans.
- Support to countries in developing a national guidance manual for sound management of health-care waste.
- Support to countries in developing and implementing a national plan, policies and legislation on health-care waste.
- Promotion of the principles of environmentally sound management of health-care waste as set out in the Basel Convention.
- Support to allocate human and financial resources to safely manage health-care waste in countries.

2.8.1.1 Basic laboratories – Bio safety Levels 1 and 2

Diagnostic and health-care laboratories (public health, clinical or hospital-based) must all be designed for Biosafety Level 2 or above. As no laboratory has complete control over the specimens it receives, laboratory workers may be exposed to organisms in higher risk groups than anticipated. This possibility must be recognized in the development of safety plans and policies. In some countries, accreditation of clinical laboratories is required. Globally, standard precautions should always be adopted and practiced.

Code of practice

Code of practice is a listing of the most essential laboratory practices and procedures that are basic to GMT. In many laboratories and national laboratory programs, this code may be used to develop written practices and procedures for safe laboratory operations. Each laboratory should adopt a safety or operations manual that identifies known and potential hazards and specifies practices and procedures to eliminate or minimize such hazards. GMT are fundamental to laboratory safety. Specialized laboratory equipment is a supplement to but can never replace appropriate procedures. The most important concepts are listed below.

Access

The international biohazard warning symbol and sign must be displayed on the doors of the rooms where microorganisms of Risk Group 2 or higher risk groups are handled; Only authorized persons should be allowed to enter the laboratory working areas; Laboratory doors should be kept closed; Children should not be authorized or allowed to enter laboratory working areas

Personal protection

Laboratory coverall gowns or uniforms must be worn at all times for work in the laboratory; appropriate gloves must be worn for all procedures that may involve direct or accidental contact with blood, body fluids and other potentially infectious materials or infected animals. After use, gloves should be removed aseptically and hands must then be washed; Personnel must wash their hands after handling infectious materials and animals, and before they leave the laboratory working areas.

At Biosafety Level 2, an autoclave or other means of decontamination should be available in appropriate proximity to the laboratory.

2.8.1.2 Guidelines for the surveillance of laboratory workers handling microorganisms at Bio safety Level 2

A pre-employment or pre-placement health check is necessary. The person's medical history should be recorded, and a targeted occupational health assessment performed; Records of illness and absence should be kept by the laboratory management; Women of childbearing age should be made aware of the risk to an unborn child of occupational exposure to certain microorganisms, e.g. rubella virus. The precise steps taken to protect the fetus will vary, depending on the microorganisms to which the women may be exposed.

The international biohazard warning symbol and sign displayed on laboratory access doors must identify the biosafety level and the name of the laboratory supervisor who controls access, and indicate any special conditions for entry into the area, e.g. immunization. Laboratory protective clothing must be of the type with solid-front or wrap-around gowns, scrub suits, coveralls, head covering and, where appropriate, shoe covers or dedicated shoes. Front-buttoned standard laboratory coats are unsuitable, as are sleeves that do not fully cover the forearms. Laboratory protective clothing must not be worn outside the laboratory, and it must be decontaminated before it is laundered. The removal of street clothing and change into dedicated laboratory clothing may be warranted when working with certain agents (e.g. agricultural or zoonotic agents); Open manipulations of all potentially infectious material must be conducted within a

biological safety cabinet or other primary containment device; Respiratory protective equipment may be necessary for some laboratory procedures or working with animals infected with certain pathogens.

2.8.1.3 WHO National Guidelines on Safe Disposal of Pharmaceutical Waste, 2001

The provisions of these guidelines describe a series of steps that need to be followed in order to dispose waste and or expired pharmaceuticals. The steps required include identification of pharmaceutical waste, sorting of pharmaceutical waste by category, filling the relevant forms to seek authority from the authorities in charge of disposing such waste. Upon obtaining all the relevant approvals, the disposal of the pharmaceutical waste shall be affected under the supervision of the local pharmaceutical waste disposal team or the Waste ManagementTeam.

They recommended methods for disposing of unwanted pharmaceuticals. These include: The use of either medium temperatures incineration at a minimum of 850 degrees Celsius or high temperature incineration exceeding 1200 degrees Celsius with two chamber incinerator for solids, semisolids and powders for controlled substances e.g. anti-neoplastic.

1. Engineered sanitary landfill to be used for disposal of expired or unwanted pharmaceuticals.
2. Sewer disposal for diluted liquids, syrups, intravenous fluids, small quantities of diluted disinfectants and antiseptics. These guidelines are relevant in informing the generator of pharmaceutical wastes on safe disposal methods. The proponent shall however contract a licensed waste handler who disposes the pharmaceutical wastes in the manner provided by the legal framework and the best international practice and guidelines.

2.8.2 World Bank policies and Guidelines

2.8.2.1 World Bank Environmental and Social Standards

The World Bank Group Strategy sets out the corporate goals of ending extreme poverty and promoting shared prosperity in all its partner countries. Securing the long-term future of the planet, its people, and its resources, ensuring social inclusion, and limiting the economic burdens on future generations will underpin these efforts. The two goals emphasize the importance of economic growth, inclusion, and sustainability— including strong concerns for equity.

According to the World Bank Environmental and Social Framework (ESF), projects supported by the Bank through Investment Project Financing are required to meet the Environmental and Social Standards (ESS). The ESSs are designed to help Clients to manage the risks and impacts

of a project, and improve their environmental and social performance, through a risk and outcomes-based approach. Clients are required to manage environmental and social risks and impacts of the project throughout the project life cycle in a systematic manner, proportionate to the nature and scale of the project and the potential risks and impacts. Table 3 describes the ESS that are applicable to the present ESIAdocument.

The Bank requires environmental assessment (EA) of projects proposed for Bank financing to help ensure that they are environmentally sound and sustainable, and thus to improve decision-making. EA is a process whose breadth, depth, and type of analysis depend on the nature, scale, and potential environmental impact of the proposed project. EA evaluates a project's potential environmental risks and impacts in its area of influence; examines project alternatives; identifies ways of improving project selection, siting, planning, design, and implementation by preventing, minimizing, mitigating, or compensating for adverse environmental impacts and enhancing positive impacts; and includes the process of mitigating and managing adverse environmental impacts throughout project implementation.

Table 3: Summary of ESSs triggered by the Vaccine Laboratory Project

World Bank (ESS)	**Applicable**	**Explanation**
ESS1: Assessment and Management of Environmental and Social Risks and Impacts	Yes	The proposed project is classified as substantial risk and it triggered to ESS1. Preconstruction phase activities, like site clearing will cause erosion, siltation, and changes in natural water flow during summer. Under construction phase, the project will have environmental, occupational safety and health impacts and risks of construction phase, include air pollution, soil pollution and erosion, noise, and vibration impact, Impacts on landscape and visual receptors, traffic and public safety impacts, wastewatergeneration Impacts, solid waste generation Impacts, Impact on plant and animal biodiversity. Moreover, it has social impacts and risks includingsocial conflict and crime, gender-based violence, Impact on traffic and public safety, and child right violation impacts. This project also has environmental and social impacts during operation phase. Thus, ESS1 is relevant to

		the Vaccine Laboratory project.
ESS2: Labor and Working Conditions	Yes	The vaccine laboratory complex project will engage public workers, workers hired by the project (direct workers such as consultants, technical experts, suppliers, and other workers), and workers hired by contractors under the project. The project may outsource minor works to contractors. The envisaged works will be of minor scale and thus pose limited risks. Also, no large-scale labor influx is expected due to the same circumstance. Thus, ESS2 remains relevant and is triggered by the Vaccine Laboratory project. The project will ensure a basic, responsive grievance mechanism to allow workers to quickly inform management of labor issues via MoH. The Labor Management Procedures (LMP) will be prepared for the for Project. The LMP provide detailed information on the work terms and conditions; and procedures to address workers grievances.
ESS3: Resource Efficiency and Pollution Prevention and Management	Yes	Medical wastes and chemical wastes (including reagents, infected materials, etc.) from the laboratory activities can have significant impact on environment and human health. During operation phases, wastes that may be generated from labs could include liquid contaminated waste, sharps, chemicals, and other hazardous materials which can pollute the environment if improperly managed. The laboratory activities require more energy and water may burden to public water and energy resource. The Project activities will also need to consider alternatives and implement technically feasible activities to reduce project related GHG emissions such as use of the renewable energy sources and implementation of the energy efficiency

		measures in all laboratory facilities. These are among the major concern that seek due attention during project implementation to ensure efficiency in resource use. As a result, ESS 3 will be relevant to the subproject activities and remains relevant to the vaccine laboratory Project.
ESS4 Community Health and Safety	Yes	Medical wastes and general wastes from laboratory activities have a high potential of carrying micro-organisms that can infect the community at large if it is not properly disposed of. The operation of laboratory facilities needs in line with international best practice. This includes addressing avoidance of any form of Sexual Exploitation and Abuse as well as protocols in case of use of security personnel. The vaccine laboratory activities would need to ensure these and other aspects of it are properly managed to avoid adverse risks on community health. Thus, ESS4 is relevant and is triggered by the vaccine laboratory project. ESS4 is also relevant with regard to provisions for GBV, i.e., as part of the communication component, the Project has and will continue to include messages related to GBV and sexual harassment, as well as GBV referral services.
ESS5 Land Acquisition, Restrictions on Land Use and Involuntary Resettlement	No	The proposed Vaccine Laboratory will be constructed within the premises of government owned land. As a result, the project is not expected to cause any Land Acquisition, Restrictions on Land Use and involuntary resettlement or loss asset.Thus, ESS 5 is not relevant to this Project.
ESS6 Biodiversity Conservation and Sustainable Management of Living Natural Resources	Yes	The proposed vaccine lab project is going to be built in the government owned land found in predominantly urban core settlement. Hence, likely impacts of the project on natural resources and biodiversity are low. However, if medical and chemical wastes are not properly disposed of, they can have impacts on living natural resources. ESMPs will be

		prepared. Hence, ESS 6 is relevant for this project.
ESS7 Indigenous Peoples/Sub-Saharan African Historically Underserved Traditional Local Communities(SSAH UTLC)	No	The proposed Vaccine Laboratory project is going to be built within the pre-owned premises of the MOH, where there are no known SSAHUTLC.Thus, the project will not trigger ESS7.
ESS8 Cultural Heritage	Yes	The proposed Vaccine Laboratory project is going to be built within the pre-owned premises of the MOH, where there are no known cultural heritage sites. However, since excavation will be conducted before constructing the Vaccine labs building, it will be inappropriate to neglect the possibility of chance finds. The likely impact of the project on cultural heritage is low.Thus, the proposed project will trigger ESS8.
ESS9 Financial Intermediaries	No	Financial Intermediaries (FIs) are not involved in this project.
ESS10 Stakeholder Engagement and Information Disclosure	Yes	The vaccine laboratory project will need to engage with stakeholders based upon meaningful consultation and disclosure of appropriate information, considering the specific challenges associated with construction and operation phase of this project. Particularly, rumors and misinformation monitoring, analysis and response have been done and this will continue to be implemented. The approaches taken should ensure that information is meaningful, timely, and accessible to all affected stakeholders, including usage of different languages, addressing cultural sensitivities, as well as challenges deriving from illiteracy or disabilities. The project should ensure that information disclosure takes place in an on-

		going and satisfactory manner, with clear and accessible messaging on safety of vaccines, principles of fair, equitable and inclusive vaccines access and allocation, as well as rationale for prioritizing certain groups where stakeholder engagement takes place in an on-going manner, at different levels, with different partners, and in a culturally appropriate manner. The SEP will also be amended in parallel and also address how to equip medical personnel with the necessary information to engage pro-actively with beneficiaries. People affected by Project activities shall be provided with an accessible and inclusive grievance mechanism to raise concerns and grievances. Thus ESS 10 remains relevant for the AF project.

2.8.2.2 World Bank Group (WBG) Guidelines: Environmental, Health and Safety Guidelines General EHS Guidelines

The Environment, Health, and Safety (EHS) Guidelines contain performance levels and measures for development of industrial projects that are achievable in new facilities at reasonable costs by existing technology.

Under these guidelines, the World Bank has several guidelines many of which are applicable to various components of the proposed project namely:

- EHS Guidelines-Environmental that includes Air emission and ambient air quality; energy conservation; wastewater and ambient water quality; water conservation; waste management; noise and contaminated land
- EHS Guidelines- Occupational Health and Safety
- EHS Guidelines- Community Health and Safety
- EHS Guidelines-Construction and Decommissioning and
- EHS Guidelines-Health Care Facilities

2.9. Comparison of National Requirements for HCWM and Occupational Health versus International Standards

The national requirements for hazardous waste management and occupational health and safety broadly drive from the six basic legislations that set legally binding rules which should be met by

the project proponents. This legislation includes Proclamation 300/2002 on Environmental Pollution Control, Proclamation 513/2007 on Solid Waste Management, Public Health Proclamation 200/2000, Food Medicine and Health care Administration and Control Proclamation no.661/2009, Ethiopian Water Resources Management Proclamation, No. 197/2000 and the FDRE Labor Proclamation no. 377/2003 which are briefly reviewed in the preceding sections.

From the perspectives of hazardous waste management generated from health care facilities such as the proposed Vaccine laboratory, the significant national laws that set the key requirements involve the public health proclamation 200/2000 and the Food Medicine and Health Care Administration and Control Proclamation no.661/2009. According to the Public Health Proclamation 200/2000, any solid,liquid, and other wastes generated from hospitals (i.e., health care facilities) should be handled with special care and their disposal procedures should meet the standards set by the public health authorities. Moreover, the Food, Medicine and Health Care Administration and Control Proclamation no.661/2009 of Ethiopia stipulates that handling and disposal of solid and liquid wastes derived from different institutions must not be harmful to public health; emphasis is on ensuring the availability of necessary hygiene requirements in controllable health-related institutions. In addition, it indicates that any waste generated from health care facilities must be handled with special care and their disposal procedures must meet the standards set by the relevant executive organ.

In order to enforce these framework laws of the proclamations, the FMoH and the Food Medicine Health Care Administration and Control Authority has issued two important pieces of documents that elaborate and describe the requirements for Health Care Waste Management at national level. These are the Ethiopian Health Care Waste Management National Guideline (November 2008) and the Ethiopian Medicines Waste Management and Disposal Guideline (August 2011). These directive and guideline documents set the national minimum practices that health care facilities should apply in managing their health care wastes.

On the other hand, the IFC EHS (World Bank Group) and WHO guidelines related to health care facilities are usually considered as benchmark International Good Practice Standards. More specifically, in relation to the proposed Vaccine Laboratory project the WHO Laboratory Biosafety Manual (third edition, 2004) and the IFC EHS guideline for Health care Facilities appears to be directly applicable as international best practice requirements to the proposed Vaccine laboratory project.

A comparison of the detailed requirements of the International best practice standards (i.e. the WHO and IFC EHS guidelines indicated above) with the national guidelines for health care waste management reveals that there is a great similarity in the set of requirements for the approaches, methods and procedures outlined for managing the health care wastes. The health care waste minimization, segregation, colour coding & collection, packaging, storage, sterilization, handling, transport and final disposal requirements of the MoH Health Care Waste Management National Guideline are broadly identical to those specified in different sections of the WHO and IFC EHS guidelines. Therefore, a comparison of the National HCWM requirements with the International best practice standards do not show any major gap in addressing the proper handling of the highly infectious waste anticipated to be generated by the proposed Vaccine laboratory.

With regard to emission levels released from Health Care Facilities, the above-mentioned national guideline for HCW doesn't set standards for emission released from medical waste incinerators and associated wastewater treatment facilities. As a matter of fact, there is no such emission standard for medical waste incinerators and effluent treatment plants set by the competent national authorities (i.e. EPA, MoH). However, there are such standards that can be drawn from International best practices. For example, according to the UNEP-POPs-BAT/BEP Guideline for Waste Incinerators, it is stated that with a suitable combination of primary and secondary measures, PCDD/PCDF performance levels in air emissions no higher than 0.1 ng I-TEQ/Nm3 (at 11% O2) are associated with best available techniques. It is also noted that best available techniques for discharges of wastewater from effluent treatment plants are associated with PCDD/PCDF concentration levels well below 0.1 ng I-TEQ/l. Accordingly, this is taken as the performance standards for air effluent emissions from incinerators and wastewater treatments of HCF associated with best available techniques. On the other hand, the IFC EHS guideline for Health Care Facilities also provides emission levels for air and effluent releases as shown in the following table 4 (Air Emission Levels for Hospital Waste Incineration Facilities).

It is worth to note that the WBG EHS emission standards for PCDD/F from HCW incinerators are in agreement with the UNEP-POPs-BAT/BEP Guideline for Waste Incinerators.

2.10. Institutional Roles and Responsibilities ESIA

The relevant institutions responsible for the regulation of ESIA include the Federal Environmental Protection Authority (EPA) and the Regional Environmental Authorities, in this case, the Addis Ababa Environment Protection Authority.

Federal Environment protection Agency (EPA) is the lead agency responsible for formulating policies, strategies, laws, and standards to ensure social and economic development activities sustainably enhance human welfare and safety of the environment (Article 6, Proclamation 295/2002). The regulation of EIA is one of the key responsibilities entrusted to EPA. In this respect, the EPA is responsible for establishing a system for undertaking EIA in public and private sector projects. The EPA is responsible for developing a directive that identifies categories of projects likely to generate adverse impacts and require a full EIA, and for issuing guidelines that direct preparation and evaluation of EIA reports (Proclamation 299/2002, Articles 5 and 8).

In addition, the EPA is responsible for evaluating ESIA reports of the projects that need to be licensed and executed by the federal government and projects that are likely to generate inter - regional impacts. The EPA is also responsible for monitoring, auditing, and regulating implementation and performance of such projects. The EPA holds primary responsibility for providing technical support on environmental protection and management to regional states and sector institutions

Regional environmental bodies: Proclamation 295/2002 requires regional states to establish or designate their own regional environmental agencies. The regional environmental agencies are responsible for coordination formulation, implementation, review and revision of regional conservation strategies as well as environmental monitoring, protection and regulation (Article 15). Relating to EIA specifically, Proclamation 299/2002 gives regional environmental agencies the responsibility to evaluate EIA reports of projects that are licensed, executed, or supervised by regional states and that are not likely to generate inter-regional impacts. Regional environmental agencies are also responsible for monitoring, auditing, and regulating implementation of such projects. In case of Addis Ababa, the City Administration has established the **Addis Ababa Environment ProtectionAuthority** in the early 1990s. The Addis Ababa regional EPA has also promulgated regulations that include "AACG Environmental Impact Assessment Regulation 21/2006".

Sector environment units: The sector environmental units, stipulated in the Environmental Protection Organs Establishment Proclamation (295/2002), are to be established in every competent sector institution (i.e., the line ministry and regional sector agencies). These units have the responsibility of coordinating and implementing activities in line with environmental protection laws and requirements (Article 14, Proclamation 295/2002). Article 13 of the EIA

Proclamation 299/2002 requires that public instruments undertake EIA. To this end, sector environmental units play an important role in ensuring that EIA is carried out on projects initiated by their respective sector institution.

Delegated authority: The EPA has delegated authority to sector institutions to ensure implementation of EIAs in their sector and to undertake EIA reviews. For instance, the Federal Ministry of Water and Energy is responsible for ensuring that an EIA is undertaken on water and energy projects and to review the EIA. This delegation has been communicated to sector ministries through an official letter sent by the EPA.

The organization of additional environmental and social management roles and responsibilities within the health sector are described below.Table 4 summarizes the roles and responsibilities of institutions involved in environment and social management in Ethiopia. Identification of institutional roles and responsibilities takes into account potential environmental implications of the project activities and the requirements.

Table 4: Institutional Roles and Responsibilities

Entity	Roles and responsibilities for environmental and social management
Federal Environmental Protection Authority	As the national entity for environmental management, EPA is responsible for: ▪ Enforcing and ensuring compliance to the EIA proclamation on FederalLicensed projects ▪ Reviewing EIAs and monitoring the implementation of EIArecommendations on Federal Licensed projects ▪ Regulating environmental compliance and developing legal instruments that ensures the protection of the environment, coordinating, advising, assessing, monitoring and reporting on environment-related aspects and activities.
Federal Ministry of Health, Engineering Service Directorate	▪ Monitoring implementation of mitigation actions by contractors ▪ Coordinating and providing training and capacity building where planned ▪ Periodically report to MoH about implementation of the ESMP
Ministry of Water and Energy	Prevent and control pollution of water resources.
Addis Ababa Labor and Social affairs Bureau	Enforce occupational health and safety in workplaces in line with its mandates, roles and responsibilities.
Addis Ababa Environment Protection Authority	▪ Enforcing and ensuring compliance to the Regional EIA proclamation on projects licensed by the Addis Ababa Administration

	▪ Reviewing EIAs and monitoring the implementation of EIA recommendations of projects licensed by the Addis Ababa Administration ▪ Regulating environmental compliance and developing legal instruments that ensure the protection of the environment.
Ethiopian Food and Drug Authority	▪ As project owner provide necessary resources, guidance and supervision for preparation of the ESIA/ESMP ▪ Provide necessary resources, guidance and supervision for implementation of the ESIA/ESMP recommendations during operation period of the Vaccine laboratory

The Engineering Service Directorate (ESD) ensures efficient and effective use of essential public health services, human resources, health information technology and infrastructure necessary for accessible and quality health service delivery at the national level. With respect to its work pertaining on health facility expansion and rehabilitation, the Directorate:

- Manages health facility construction contracts and supervises building sights.
- Designs health facilities and allocation of medical equipment.
- Sets construction standards and provides information and consultancy services regarding construction of health facilities.
- Coordinates and oversees safe, secure, and environmentally sound operation and maintenance of appliances, including air conditioners, boilers, stoves, water supply and sewerage systems and medical equipment.
- Develops facility standards for essential civil works.

This Directorate is responsible for ensuring that the design of all facilities incorporates provisions for addressing environmental impacts, including facilities for infectious and hazardous healthcare waste management. The Directorate is responsible for developing environment, health, and safety standards for contractors, incorporating such requirements in healthcare facility construction contracts, and monitoring compliance of contractors to these requirements. The Directorate's facility design for health Centers is stringent when considering the environmental aspects of incinerators included in the design developed by the Directorate.

The Ethiopian Food and Drug Authority (EFDA) will be responsible for running the proposed Vaccine Laboratory during its operational phase. The role of EFDA during operation and verification of the proposed Vaccine laboratory including Occupational health and safety risk management are outlined in detail in section 5.4.3. As the daily operations of the proposed vaccine laboratory will be managed by EFDA, it will also assume the responsibilities for

managing the health and safety procedures of the proposed laboratory, proper operations of the health care solid waste incinerators and wastewater treatment plant, and the overall management of environmental and social risks that may occur during the operational phases of the proposed project. The Management of EFDA will put in place the necessary staffing dedicated to supervising and control the environmental and social soundness of the daily operations of the laboratory.

3. DESCRIPTION OF ENVIRONMENTAL, SOCIAL AND ECONOMIC BASELINE DATA

3.1. Description of the Bio-physical Environment

3.1.1. Biological environment /Flora and Fauna/

Flora

The site is endowed with a wide variety of both exotic and indigenous tree species which are providing various ecosystem services in the project area. The trees are planted by local communities. Some of the tress which is found in and around the project area described below.

Acacia Abyssinica (Locally named as Girar):

Usually have an average height of 16m tall, with Yellowish brown bark when they are young and Reddish-brown bark when they get older. They are fast growing, known to improve soil fertility and are drought tolerant. They are recommended for Parking shades, road shades, fencing purposes for different zones, as they have a long branchless trunk that won't obstruct view of traffic and checking out availability of parking spaces, whilst providing a wider shade due to their wide canopy.

Juniperus procera (Tid):

It is an Ethiopian endemic shrub or tree up to 6 m with a flattened crown with irregular shaped trunks. For such matter it is recommended for parks and healing quarters as they will create organic feel to the environment, that is the core essence of nature and design of such spaces. Furthermore, also in conserved areas for mix. Additional rationale for recommendation of this specific plantation is they have been classified as near threatened by IUCN due to man-made deforestation and they might act as conservation practice.

Croton macrostachyus (Bisanna):

They grow swelling, solitary trunks to 25 meters high, and 1 meter in diameter at the base. The green leaves — 3 to 4 meters wide — are carried on petioles — 2 meters long — which are armed with spines. The crown shaft is spherical to 7 meters wide; the leaves are round with stiff leaflets, segmented a third or half-way to the petiole. In male plants the flower is small and inconspicuous; females grow larger, 2 centimeters flowers which produce yellow to brown fruit resembling the coconut containing up to 3 seeds.

Eucalyptus globulus (Bahir Zaf):

Their species are shrubs to large trees ranging in size from 20 to 30 m tall. Their leaves are bi-pinnate in most species, pinnate or simple in a few species. The flowers are produced in conspicuous large panicles, each flower with a five-lobed blue to purple-blue corolla; a few species have white flowers. The fruit is an oblong to oval flattened capsule containing numerous slender seeds. The genus differs from other genera in the Bignoniaceae in having a staminode that is longer than the stamens, tricolpate pollen.

Cordia Africana (Wanza)*:*

These are a small to medium-sized evergreen tree, 4-15 (30)m high, heavily branched with a spreading, umbrella-shaped or rounded crown. Bole typically curved or crooked. Bark greyish-brown to dark brown, smooth in young trees, but soon becoming rough and longitudinally fissured with age; young branchlets with sparse long hairs.

Figure 2*: Bisana (Croton macrostachyus)*

Figure 3*: Bahir Zaf (Eucalyptus globulus*

Figure 4*: Tid (Juniperus procera) (Left) and Girar (Acacia abyssinica) (Right)*

Fauna

This part of the study deals with the presence of domestic and wild animals within the radius stated. Thus, based on the site observation and interview made with some of the residents of the study area the domestic animals such as cattle and sheep, donkeys, etc. are found in the study area.

3.1.2. Physical Environment

3.1.2.1. Topography and Climate

Climate is influenced by latitude, altitude, land and water surfaces, mountain barriers, local topography, and such atmospheric features as prevailing winds, air masses and pressure centres. Although Ethiopia is located in the tropics, temperatures vary greatly with altitude and large climate variation, from hot arid to cool temperate, exist in the country.

The seasonal distribution of rainfall in the project area is associated with the annual progression of the Inter Tropical Convergence Zone (ITCZ). The area characterized by bimodal rainfall pattern with a short rainy season (Belg) from February to March and a long rainy season (Kirmet) from June to September with a peak in August.

In the summer months, mainly from July to September, a strong air current moves from the southwest towards the northeast. This current brings moisture from the Gulf of Guinea to the Upper Awash and Abay (Blue Nile) watersheds. Thus, there are two seasonal weather patterns in the region of Addis Ababa, and these are clearly observed and reflected by the weather observation records. The weather is relatively cool in the wet season of July to September when the main rains fall, while the more or less rainless season of October to June has warmer

temperatures with easterly winds. Rainfall usually occurs in the form of localized thunderstorms due to convective heating of the air masses during the day and rapid cooling at night.

As per the data obtained from the study conducted by Beles Engineering PLC in 2013 on the ESIA of the Kaliti Wastewater Treatment Plant and Sewer Lines Expansion and Rehabilitation Project**,** there are at least five meteorological stations. The stations are located at Addis Ababa Observatory, Addis Ababa Bole, "Akaki Mission", "Entoto" and "Sendafa" areas. Table 9 shows the summary of the long-term average meteorological data obtained from stations in Addis Abba area.

The mean annual total rainfall at Addis Ababa observatory for the period 1980 – 2005 is about 1187.4 mm. The minimum arithmetic mean monthly rainfall amount in the basin was recorded in December (6.2 mm) and the maximum value was for the month of August (272.9 mm). Most stations in elevated areas recorded higher values. Many of the rivers in Addis Ababa area are highly polluted due to the release of solid and liquid waste that is being flushed by surface runoff and direct release from industries and households.

The highest and lowest mean maximum temperature over the record periods (Table 9) is 24.7^0C in dry season (March) and 20.4^0C in wet season (August), while the variation of mean monthly temperature values falls in the range of 7^0C (in the month of December) to 12^0C (in the month of March). The daily variation in temperature in the area is more pronounced than the annual variation. The calculated mean annual temperature is around 16.3^0C (Beles Engineering, 2014).

The highest relative humidity was 78% recorded in the months of July and August, and the lowest was 53% recorded in the month of December (from 1964 – 1989). The lowest sunshine hour, 3 hours per day was recorded in July and the highest 9.5 hours per day, which was recorded in December for the years (1965 –1985). Likewise, maximum wind speed of 1.2m/sec and minimum value of 0.5m/sec were recorded for the months of October and August, respectively.

3.1.2.2. Geology and Soils characteristics of the project area

3.1.2.2.1. Regional Geology

Addis Ababa city is situated in the western margin of the Main Ethiopian Rift and represents a transition zone between the Ethiopian Plateau and the rift with poorly defined escarpment.

The geology of Addis Ababa area is represented by four volcanic units delineated in the lower part by basaltic lava flows (Addis Ababa basalt), followed by a pyroclastic salience, mainly

formed by ignimbrites (Addis Ababa Ignimbrite), followed by central composite volcanoes (Central Volcanoes unit), and finally small spatter cones and lava flows (Akaki unit.).

Addis Ababa basalt extensively crops out along Akaki, Kebena, and Dukem rivers at the east to southeastern part of Addis Ababa and represents the oldest unit of the area. It consists of essentially sub-horizontal lava flows with thickness ranging from few meters up to 20m. Maximum exposed thickness was found east of Addis Ababa, along the Kebena River. Addis Ababa basalt is predominantly constituted by alkaline and olivine basalts with three main textural attributes, that is, porphyritic, aphyric, and sub-aphyric.

Central volcanoes unit includes the Yerer volcano and the product of the two composite volcanoes wechecha and Furi west and southeast of Addis Ababa, respectively. Wechecha and Furi volcanoes are two large edifices composed by predominant trachyte with minor pyroclastics. Yerer represents the largest volcanic edifice.in the region, with a relief of 100m from the plain and 14km wide along east-west direction. Products mainly consist of trachytes, even if pyroclastics are widespread mainly in the central part eastern sector. The highest part of Yerer volcano was affected by a more recent volcanic activity that produces spatter cones and associated basalt.

Akaki unit crops out east of Addis Ababa and consists of scoria and spatter cones with associated tabular lava flows and phreato-magmatic deposits. Alluvial deposits covering these units consists of regolith, reddish brown soils, talus and alluvium with maximum thickness of about two meters.

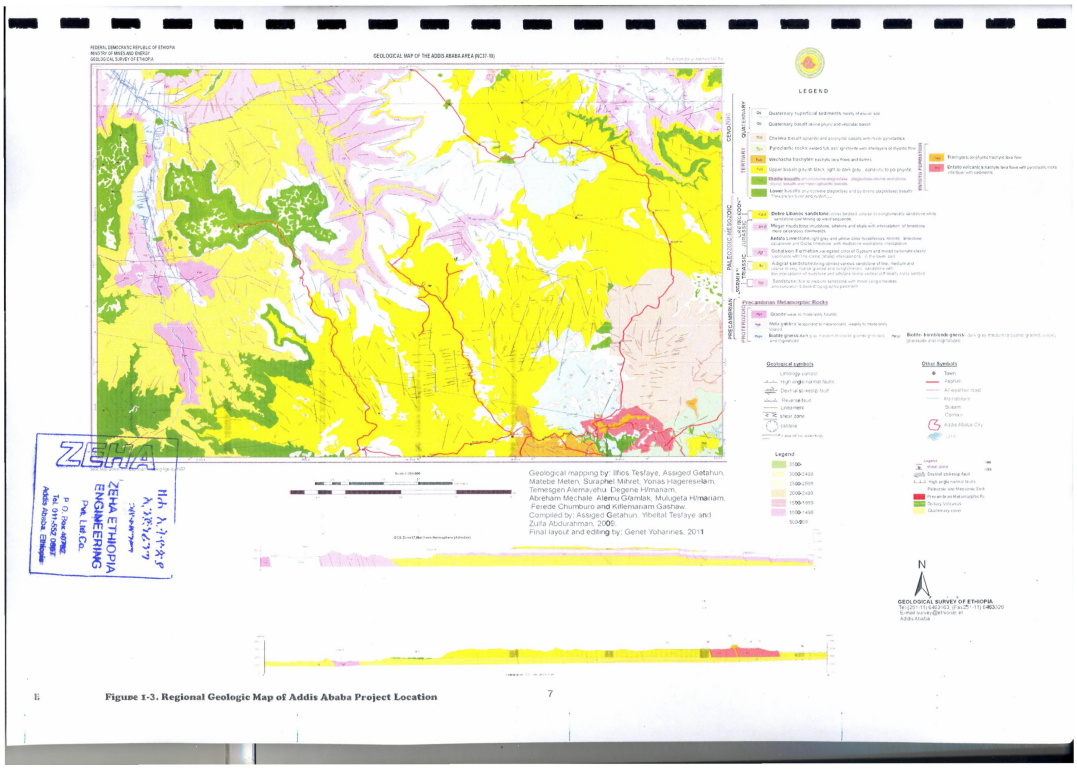

Figure 5: Regional Geological Map of Addis Ababa Project Location

3.1.2.2.2. Properties of Soil

As it was depicted on the study conducted for soil investigation by (Engidasew & Abay, 2016)terites are the products of intensive and long-lasting tropical rock weathering assisted by high rainfall and elevated temperatures. In practice, laterite formation requires particular conditions which concentrate the iron and aluminum rich weathering products sufficiently to allow concretionary development, resulting in a cemented horizon within the profile. Hence, the process involves tropical weathering to produce the minerals of laterite, concentration of these minerals in a discrete horizon, and concretionary development within the horizon. The factors that affect the development of laterites are climate, topography, and drainage. Laterites can be formed from any rock, but the speed with which they are formed is to a certain extent governed by the availability of iron and aluminum, and the amount of silica. Hence, basic igneous rocks, which contain high amount of iron and aluminum, can easily form laterites under oxidation. Rocks rich in quartz, on the other hand, resist weathering and may not degrade into laterite easily and quickly. Instead, the end product in these rocks is a granular soil with fine materials forming the matrix around quartz nuclei. Climate controls the formation of laterites more than any other factor as laterites in general require hot, humid conditions. A mean annual temperature of 250C has been suggested for their formation. The minimum annual rainfall is thought to be around

750mm. The higher the rainfall above this value, the greater is the leaching effect, which removes free silica. Topography affects the amount, rate and direction of water flow in an area.

On steep slopes, weathering products are quickly removed by running water before they are changed into laterites or red soils. On gentle slopes, erosion is limited, and long uninterrupted weathering provides time to produce laterites. On level ground, on the other hand, drainage is impeded, and the area becomes waterlogged to form black soils at the expense of laterites. In addition, the concentration of weathering products in distinct horizons in a laterite profile can be linked to fluctuating groundwater following seasonal changes in climate.

However, many laterites are ancient (Tertiary) deposits which can now be found in very different climatic and landscape conditions from those in which they were first formed. In Ethiopia, they are distributed in the north-western, western, and southern part of the country and also some part of Addis Ababa as shown in the figure below. Laterites show an irreversible change in plasticity on drying. This is partly because dehydration of alumn-oxides creates a stronger bond between the particles, which is resistant to water. The process cannot be reversed by rewetting. The effect takes place during air-drying but becomes more pronounced on oven drying at higher temperatures.

Another aspect of lateritic materials which is relevant for road construction is their self-hardening nature that increases their strength. This is seen as a time-dependent improvement in performance. Any potential improvement in performance because of self-hardening is dependent on the proportion of oxides present in the matrix. Immature or relatively young laterites, known as plinthite, are the most likely to exhibit self-hardening.

However, they lack a mechanically stable grading for use in road construction. Immature nodular laterites may also have self-hardening properties and could undergo significant improvement with time. Hence, the laterites which are normally considered mechanically unstable and too plastic using standard requirements have been known to give satisfactory performance in service. For this reason, many nodular laterites can be used as base, sub-base and gravel wearing courses, especially for low volume roads.

3.1.2.3. Water resources

Surface Water Resources

The main surface water resources present in and around Addis Ababa are the Akaki Rivers which traverse the city from north eastern and north western parts of the city down to the southern plains culminating at Lake Aba-Samuel. The Gulele area is one among those which form the upper catchment and head waters/springs for the Akaki River Basin. The catchment area of the Akaki river basin is divided into two sub-catchment areas. These are the Great Akaki River (Eastern and South eastern) sub-catchment and the Little Akaki river (Western and south western) sub-catchment. Within the Akaki river basin, there are several perennial rivers. The most important ones are Big Akaki, Little Akaki and Kebena. The vaccine lab project area is situated within the Akaki river basin. It is observed that the great and little Akaki are also the major carriers of wastes released into it and its small tributary streams. The wastes entering into the river systems include municipal and industrial wastes of solid and liquid nature. As a result, the rivers are observed to sustain continued water pollution as has been confirmed by numerous studies(Mazhinduet al., 2012). The Akaki Rivers and its catchment belong to the Awash Basin.

Water Supply

Addis Ababa has not yet reached full coverage of water supply or sewerage, and also faces significant and growing water scarcity. It is estimated that only 44% of the population has access to clean water 23 and 30% has access to piped sewerage or vacuum truck service. Addis Ababa has two sources of water – surface and groundwater. Surface water comes from 3 dams that feed into 2 treatment plants such as Geffersa, Legedadi, and Dire Dams. They are in the east and northwest of the city and flow to the city with gravity. There are 3 primary well fields for groundwater extraction with a total of about 50-60 wells. They are in the southeast section of the city. Water is collected into tankers via gravity and treated, and then pumped to the city. The per capita distribution is estimated to be around 40 litres /day, well below the city's goal of 110 litres /day(Tilahun andBeshaw, 2020). Ababa Water and Sewerage Authority (AAWSA) is currently supplying water to certain parts of the city on a rotating basis, with some areas receiving water only two days a week through distribution lines or water truck.

3.1.2.4. Waste management facilities

The Addis Ababa City Administration, UNDP MDG Carbon and UNDP Ethiopia Country Office worked together to support the development of the Repi Landfill Gas Clean Development Mechanism (CDM) Project under the United Nations Framework Convention on Climate Change (UNFCCC). This project is responsible to convert non-hazardous solid waste generated in the

city to power energy. It is close to the existing landfill which introduces better management practices of municipal solid waste in Addis Ababa. This includes modern technology, sorting facilities for recycling and collection of municipal solid waste and the opening of a new landfill site under best practice management standards. The project demonstrates a combination of economic benefits, social benefits, and environmental benefits. Regarding hazardous medical solid waste, there is no central waste treatment plant in Addis Ababa. But there is a new centralized incinerator built by ministry of health in Adam town 90 km away from Addis Ababa designed for incineration of pharmaceutical and medical waste. This approach would reduce health and environmental pollution risks that would arise from several inefficiently managed and run incinerators or burning pits/burials pits. However, the major drawback of this approach is that it will require a transportation infrastructure and, there is a risk during transportation of the waste from Vaccine labs to centralized Incineration place as well as expensive.

3.1.2.4.1. Wastewater Treatment and Drainage

Sewage disposal is the responsibility of the Addis Ababa Water Supply and Sewerage Authority (AAWSSA). It operates with seventeen wastewater treatment plants. The main ones are Kality and Kotebe and in twelve condominium areas. The sewer line is connected to Kality treatment plant and sludge is transported to Kotebe treatment plant using vacuum trucks that empty septic tanks. The treatment involves circulation of sewer in various ponds for about 30 days in order to make the level of BOD fall below 5mg/L Addis Ababa has two main sewage treatment plants which are Kality and Kotebe treatment plant. The Kality had capacity of 7,600 m^3/day wastewater treatment however, according to Addis Ababa Water and Sewerage Authority (AAWSA), currently the project expansion has been upgraded to capacity of 100,000 m^3/day to treat wastewaters with the support of the World Bank and the Kality treatment plat had an ESIA that approved by EPA as well as by World Bank. Besides, it is supervised and monitored by Federal and Addis Ababa EPA regularly for fulfillment the requirements and regulation.

The other main treatment plant is called Kotebe treatment plant; it receives only sludge from vacuum trucks that empty septic tanks. The Kotebe treatment plant was established 22 years ago by Addis Ababa Water Supply and Sewerage Authority with objective to treat and dispose of sludge collected form the city with the capacity to treat volume of 85,000 m^3/day. In addition, Addis Ababa Water Supply and Sewerage Authority introduces expansion project to increase the capacity and efficiency of the treatment plant by additional 80,000 m^3/day in the coming few

years. According to the Addis Ababa Water and Sewerage Authority, the Kotebe treatment plant had an EIA that approved by Ethiopian Environmental Forest Climate Change Commission; however, we did not get documented EIA from the organization as it was established several years ago. But the current expansion the treatment plant has an approved EIA document.

Addis Ababa city administration provided legal certificate including site plan to Addis Ababa Water Supply and Sewerage Authority to establish and manage the Kotebe treatment plant. The treatment plant is established in the territory Northern part of the city far away from residential and business center and there is no any sensitive area receptor around the treatment plant. In addition, it is supervised and monitored by Federal and Addis Ababa Environmental EPA regularly. In general, the Kotebe treatment plat has been performing according to the Ethiopian National Environmental Proclamation 300/2002, Environmental Pollution Control, and regulation.

In addition to this, there are also several decentralized treatment plants that primarily serve condominiums. Industries are not connected to the system; they handle their own treatment, and it is overseen by the Addis Ababa EPA.

3.2. Social and Socio-Economic Environment

3.2.1. Population and Settlement

According to the data obtained from the field observation, there were no settlement in the project site and the site is already fenced. The proposed area and its surrounding are intended for industrial use as well as for the different insurance companies to store different damaged vehicles. At the far distance of the project site there is a scattered settlement observed and they said that about the project, they did not have any negative attitude towards this project like loss of land (acquisition/deforestation), damage to farmland, pollution of air/waterways, health problems, socio-cultural interference and high cost of living because this development has a high potential to absorb a number of unemployed people so that we have to cooperate for the success of the project.

3.2.2. Social and Economic Infrastructures

3.2.2.1.Education

As the data obtained from the Woreda 05 Education Office, the total number of schools is 16, more 314 teachers and 6,195 of students found in the Woreda. From these it was understood that the services give for Woreda people is in terms of the provision of education was appreciated.

3.2.2.2. Health Services

As the data obtained from the Woreda 05Health Office, there were 21health facilities, and 27 health professionals and the typhoid and typhus were the leading ten top diseases of the Woreda. From these, it could understand that the services give for woreda people is in terms of the provision of health was appreciated.

3.2.2.3. Economic Activities

As indicated earlier, the area is somehow inhabited by people engaged in rural livelihood. Traditional mixed farming type of agriculture dominated by rain-fed farming is currently the most important economic activity. Livestock ownership is comparatively low and is primarily geared towards having some oxen and donkey as well as cattle and sheep required for the farming activities and transport. In the area, there are also different high and medium size storages and factories which play significant roles for the economic activities of the city and the country in general.

3.2.2.4. Religious, cultural, Historical, and archaeological Resources

Site investigation by the EIA Consultant and discussions with relevant stakeholders and the inhabitants of the area themselves confirm that there are no recorded historical, cultural and archaeological heritage sites in the area. Similarly, there are no monuments, historical buildings, holy trees/springs or old burial grounds identified within the project area.

3.2.2.5. Utilities

3.2.2.5.1. Electricity

Traditional paradigm of energy supply for research facility worldwide involved access to grid power from national source and backed up by on-site fuel-based generator power. Diesel generators, which have long been the default on-site power option, have become increasingly expensive to fuel and maintain. As a proportion of total health service costs, fuel costs can be particularly high, especially in the most resource-constrained settings. Therefore, Diesel generators are preferred if and only if the power supply is interrupted. The MOH/EFDA should

also consider using on-site renewable energy sources such as solar energy either as a primary or backup source for minor operations such as road lightening.

3.2.2.5.2. Water

Water is required both for domestic and laboratory service uses. Domestic water includes both for drinking and cleaning purposes. Vaccine laboratory uses include water used for cleaning, solvent, sanitary facility, toilet flushing, greenery and others.

The two main options that exist for water use is to either use a variety of sources that curtail over reliance on municipal supply: borehole, and rainwater harvesting, whilst the second option curtails using the Addis Ababa water and sewerage authority. The municipal supply will be a better option for water supply demand of the proposed project. It also promotes wise use, water recycling and captures strategies that ensure effective usage and conservation of water. The disadvantages of this option are that it will involve the construction of extra facilities and management resources for the treatment plan and therefore extra costs.

3.2.2.5.3. Transport

Transportation infrastructure is vital in accessing the facility. The Project site will be accessible by own compound gate near to road infrastructure and not interrupt or and overcrowded the other day to day activities of the area.

3.2.2.5.4. Materials

Alternative for the materials that will be used in the project involve using locally procured materials and the second option involves primarily importing materials. The former alternative is preferred option since it will ensure the project contributes to the national economy by creating business opportunities for the local suppliers of these materials while conserving the environment by ensuring the most environmentally friendly suppliers are contracted. For service that demands high quality and unavailable materials, the contractor can use importing materials.

3.3. Environmental and Social Liabilities

Environmental and social liabilities to the proposed vaccine laboratory Project need to be checked in case of any unforeseen consequences that would affect the project in the long run due to some previous activities that took place in the area. According to historical data obtained by way of consultations there is no any evidence of environmental and social liability related to the site.

3.4. Assumptions and Gaps in Knowledge

Reliability and quality of data to be collected with regard to the proposed project from different sources may involve some degrees of uncertainties due to absence of sufficient information about the environment. Some gap in information and knowledge has been experienced while preparing the EIA. This basically emanated from the absence of any fully-fledged feasibility study of the proposed Ethiopian Food & Medicines Quality Assurance Center of Excellence Complex Project on which the EIA could be based.

3.5. Public and Stakeholder Consultations

Community and Stakeholders' consultations have been conducted on environmental and social issues with the concerning bodies where the project site is located and with the community residing in the project site.

The main objective of the public/stakeholder consultation was: -

- To get information on the attitude of the community towards the project;
- To obtain full information regarding the current general condition of the site facilities and critical environmental issues associated with the project; and
- To gain ideas on what should be done to avoid or minimize problems that might occur with the implementation of the project.

In order to achieve the above-mentioned objectives, key stakeholders were informed and consulted. These includes Wereda 05 Environmental Protection office, woreda Chief of Executive office, Health Office, Social Affair Office, Woreda Youth and Women Associations, the staffs of the project Office and community representatives. During consultation with some professionals, they said that the proposed project, Ethiopian Food &DrugVaccine Laboratory Complex Project, is very important for ours and for the city in particular and for the country in general. These includes,

- Being a good influence and positive motivation to the community;
- Job opportunity;
- Changing the country towards development;
- Giving community services to the society; and
- Others.

4. PROJECT ALTERNATIVES

In the early stages of the development of the proposed EASTRIP project in EFDA/MOH, different project alternative option has been considered from the point of view of site layouts, alternative designs, alternative processes, and materials. The “no action” alternative was also considered to evaluate the scenario in the absence of the project taking place.

4.1.No project alternative

Given that all stakeholders agreed up on construction of the vaccine laboratory and the fact that the “Government Development Plan Strategy” singled out health sector as one of the main challenges the country failed to fulfill, the “no action” alternative is not preferred.

Basically, this alternative describes a situation where the proposed development will not be implemented. In case this happens, positive impacts associated with the proposed development will not accrue to the stakeholders including the development consultants, contractors, and suppliers of materials. However, from an environmental management perspective, the “No action alternative” will be beneficial in the sense that any potential negative impacts associated with the project will be avoided.

However, Ethiopia currently lacks a dedicated vaccine laboratory system, and relies on the others option. This laboratory is located at MOH owned area.

The “No Action Alternative” should not be adopted, as we need to encourage development on better vaccine laboratory services so long as it is undertaken on an environment sustainable basis. The no project alternative option in respect to the proposed project implies that the status quo is maintained. This option is the most suitable alternative from the extreme environmental perspective as it ensures non-interference with the existing conditions. Under no project alternative, the proponent’s proposal would not receive the necessary approval from NEMA, proposed project would not be constructed/installed and there would be no demand for the proposed project. This option will however, involve several losses both to the laboratory and the community as a whole. The proponent will not utilize the land for the purpose it was intended for leaving the property remains idle.

In summary, the “No-action” option will undermine the huge social benefits that Ethiopia can harness from the development and operationalization of the proposed vaccine laboratory project

4.2.Alternative Site

The site selection process for the proposed vaccine laboratory project was confined to the pre-owned compound of the MOH. The compound has been instrumental in identifying and justifying the site selection for the proposed vaccine Laboratory building. The options of selecting other locations for the vaccine laboratory was simply rendered irrelevant due to the favorable conditions the pre-owned compound create for efficient use of available land.

4.3.Alternative Schedule

This option entails carrying out the proposal at a later time thereby offsetting its impacts to that time. The only benefit is improvement in baseline conditions and technologies that may be involved with the proposal. However, these are not guaranteed and it may only lead delays in development, therefore carrying out the proposed project with mitigation would be a preferred option due to this uncertainty. In addition, carrying out the proposed project at later time may lead to more operational and logistic costs due to increasing inflation and standards of living.

4.4.Alternative Designs

The vaccine laboratory building will be well organized, adequately supervised and staffed reference laboratory with the necessary space, facilities and equipment to perform all the services commensurate. The project design will ensure the compliance with the national construction quality standards for vaccine laboratory particularly standard (building material quality, mixing design, soundproof, ventilation, illumination, sanitation, radiation protection, plumbing, parking space and green area). Working environment is kept organized and clean, with safe procedures for laboratory analysis, handling of samples and waste material to ensure staff protection from unnecessary risks at all times.

The vaccine laboratory will consist of an anteroom and laboratory rooms. It will have gas-impermeable walls, ceilings, and floors. Air gaps under doors would be acceptable for directional airflow. If door gaps are sealed, the laboratory must not leak gaseous decontamination materials. The vaccine laboratory will be designed for ease of maintenance, so that access to critical mechanical equipment (ventilation ducts, fans, piping, etc.) is outside containment. The laboratory will consist of high-quality room construction with special consideration given to joints, finishes and penetrations. There will be a room for large equipment decontamination.

4.5. Technology Alternative

4.5.1. Waste Management Technology Alternative

4.5.1.1. The Sanitary Landfill Alternative

Sanitary landfills, if properly constructed and operated, could provide a relatively safe disposal method for municipal solid waste including health care wastes. This method, however, requires a larger space for compaction of each day's waste. Assessment of solid waste management facility in Addis Ababa revealed that there is only one functional landfill called Repi landfill. It has a total area is 19.2 hectares and is believed to have a capacity of 3600 tons per day. It receives only mainly household waste and non-hazardous wastes, office, and commercial wastes. The Repi landfill is not accessible for hazardous waste disposal; it will only be the preferred option for the disposal of non-hazardous waste generated from the proposed vaccine laboratory building.

4.5.1.2. The Waste Incineration Technology Alternative

Incinerators, if operated properly, eliminate pathogens from thewaste and reducewasteto ashes. However, certain types of vaccine laboratory waste e.g. pharmaceutical waste or chemical waste require higher temperatures for complete destruction. Higher operating temperatures and cleaning of exhaust gases limit the atmospheric pollution and odors produced by the incineration process.

4.5.1.3. Wastewater Treatment Plant Alternative

Even if requirement of effluent treatment plant incurs investment cost, working capital requirement, management requirement, utility, and maintenance cost, skilled professional requirement, and the budget allocated for the project, the vaccine laboratory center needs its own wastewater treatment plant even for accreditation.

4.5.1.3.1. Utilization of Existing Sewer Line

Use of a public sewer line is one of the options considered for treating and disposing liquid waste generated from the proposed vaccine laboratory 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 could be connected.

4.5.1.3.2. Onsite Retention using Safety Tank

The septic tank is the most common small-scale decentralized treatment unit for grey water and wastewater from laboratory department. It is basically a sedimentation tank. Its shape can be rectangular or cylindrical. Safety tanks are cost-effective, long lasting, low-maintenance cost, and limited technical requirements. Since the waste is hazardous, it should be stored in concrete based safety tanks which are single structure tanks. Each chamber (such as aeration chamber, clarifier, trash tank, etc.) is pre-casted separately while in the all-in-one system, all such chambers are provided in one large tank to prevent the ground water contamination.

The collected wastes should be handled, transported, and treated using wastewater treatment plant from the country to prevent the pollution of the environment by the waste. Considering the above requirements, the onsite retention of effluent wastes (infectious, hazardous and toxic) is one option of waste management system considering the volume of waste, technical requirement, and the cost of the waste management system. There is also a need to construct separate safety tank for non-hazardous liquid wastes such as sanitary and toilet wastes. Since EFDA/MOH planned to construct its own wastewater treatment plant such type of option may not be practical

4.5.1.3.3. Construction of Onsite Wastewater Treatment Plant

The teams of consultant recommend the MOH needs to construct new wastewater treatment plant for hazardous and nonhazardous wastes in collaboration of the government.Theproposed vaccine laboratory project will develop its own wastewater treatment plant for hazardous and non-hazardous liquid wastes to dispose its own generated liquid waste and the treatment plant will be constructed according to US EPA or international standard and monitored to avoid ground water pollution. The effluent from the plant must meet the national effluent discharge quality standards, including standards for effluent discharge into public sewers specified in preceding section which is based on the World Bank Group EHS guideline. The detail of the proposed new wastewater treatment technology is discussed in chapter 5, section 5.7.3.

4.6. Alternative Electricity

Traditional paradigm of energy supply for, such type of quality testing lab and research facility worldwide involved access to grid power from national source and backed up by on-site fuel-based generator power. Diesel generators, which have long been the default on-site power option, have become increasingly expensive to fuel and maintain. As a proportion of total health service costs, fuel costs can be particularly high, especially in the most resource-constrained settings. Therefore, diesel generators are preferred if and only if the power supply is interrupted. The

EFDA should also consider using on-site renewable energy sources such as solar energy either as a primary or backup source for minor operations such as road lightening.

4.7. Alternative Water

Water is required both for domestic and laboratory uses. Domestic water includes both for drinking and cleaning purposes. Vaccine lab uses include water used for cleaning, solvent, sanitary facility, toilet flushing, greenery, and others.

The two main options that exist for water use is to either use a variety of sources that reduceover reliance on municipal supply (borehole, and rainwater harvesting), and/or using the Addis Ababa water and sewerage authority. The former option which is the best case has the advantages of ensuring consistent supply while placing as minimal pressure as possible on the city water demand and infrastructure. It also promotes wise use, water recycling and captures strategies that ensure effective usage and conservation of water. The disadvantages of this option are that it will involve the construction of extra facilities and management resources for the treatment plan and therefore extra costs. Since the proposed vaccine laboratory will have wastewater treatment facilities, utilization of recycling water is one of the best options in addition to municipal water supply from Addis Ababa Water and Sewerage Authority.

4.8. Alternative Materials

Alternative for the materials that will be used in the project involve using locally procured materials and the second option involves primarily importing materials. The former alternative is preferred option since it will ensure the project contributes to the national economy by creating business opportunities for the local suppliers of these materials while conserving the environment by ensuring the most environmentally friendly suppliers are contracted. For service that demands high quality and unavailable materials, the contractor can use importing materials.

5. PROJECT DESCRIPTION

5.1.Description of the proposed project and its alternatives

The 2001 revised Environmental Impact Assessment guideline prepared by the Addis Ababa Environmental Protection Authority recognized the need to provide descriptions on the new projects. The document explicated that the projects need to be described in terms of the following basic elements put as a subtitles which are discussed based on their relevance to the project under consideration.

5.1.1. Background of the Sub-City

Akaki Kality Sub-City Administration is one of the eleventh sub-cities of the Addis Ababa City administration. The sub-city has an area of 118.08km^2 with a total population of 220,740 with 114,095 female and 106,645 male (2007 Ethiopian Central Statistics Authority). The Population density per sq. m of the sub-city is 1,869.41. There are 11 woredas in the sub-city.

The powers and functions of the sub-city includes carry out municipal functions within the bounds of the physical space located for it in accordance with the principle of decentralization and in conjunction with the center of the city, administer the Weredas under its jurisdiction, ensures the observance of law and order. The Sub-City Council is being accountable to the sub-city residents and the City Council, the sub-city council shall: endorse the sub-city's socio-economic development as well as municipal services plans, elect the Speaker, Deputy Speaker and Secretary of the Council from council members of the sub- city, elects the Chief Executive and Deputy Chief Executive of the sub-city from council members appointed by the political party with the majority of seats, endorse the appointment of the sub-city's standing committee members nominated by the Chief Executive of the sub-city, reallocates budget which has been allocated to it by the City Council, establishes committees of the sub-city council, receives from the Chief Executive of the sub-city and endorse annual and periodic reports and issues directive by which the activities of the sub-city council would be led.

Factories and Industrial Plants which are available in the Akaki-Kality Sub-City are Leather Products technology Institute, Kilinto Industrial Park, Thermo Plastic Industry, Nile Coffee Exports, Hashko Plastics and Shoe Factory, Gelan Metal works Industry, Addis Tires, Adwa Milling, Akaki Garment Factory, Akaki Textile Factory, Alfubek Aluminum and Metal Works. The following figure 6 shows the map of the Akaki-Kality Sub-City.

Figure 6: The map of Akaki-Kality Sub-City

5.1.2 Geographic Location and Administrative Division of Addis Ababa

Addis Ababa is located between 8°49'55.929" and 9°5'53.853" North Latitude and between 38°38'16.555" and 38°54'19.547" East Longitudes. According to the report of the Central Statistics Agency (CSA, 2007), the city has about 2,738,248 inhabitants (1,304,518 Men and 1,433,730 Women), which is about 60% of the total urban population of Ethiopia with the growth rate of 3.7%. Such a huge population has put a tremendous pressure of the demand for municipal services, shelter, job opportunities and infrastructure networks.

5.1.3 Location of the project area

Based on the provisions of the structural plan of the Addis Ababa, the site was primarily allocated for industrial area. But, due to the importance of the project to the national, City Administration and local development an agreement has been reached among the City Government of Addis Ababa, the Akaki-Kality Sub-City, the Woreda 05 of the Akaki-Kality Sub-City and on the need to allocate space to the EFDA (the former Ethiopian Food and Medicine Administration and Control Authority) in order to achieve the objectives set by the government for the provision of more technology based Ethiopian Food and Medicine Administration and Control Authority services for the beneficiaries /customers. The area for project is 10,500 sq. meters, which is owned by Ethiopian Ministry of Health with title deed

number 022526 and Base map number አቃ/ቃ/05/06 (See Annex)and currently fenced by HCB blocks.

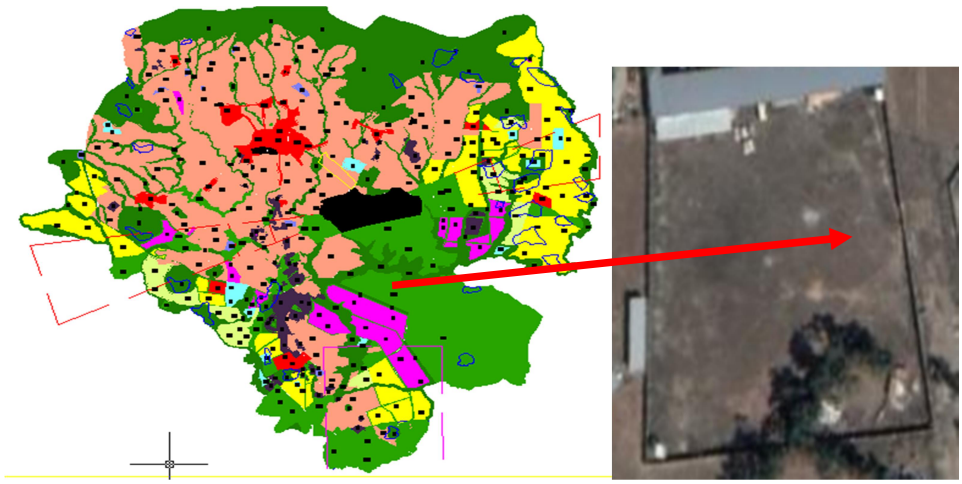

Figure 7**:** Location of the Project site at Woreda 05 of Akaki-Kality Sub-City

5.1.4 Population of the Akaki-Kality Sub-City

According to Addis Ababa Bureau of Finance and Economy report (2014/15), the population of the Akaki-KalitySub-City were 220,740 with 114,095 female and 106,645 male (2007 Ethiopian Central Statistics Authority). The gender proportion reveals that the females out numbers the males. Out of the total population of the Sub-City, 48 percent is male and 52 percent cover female population.

5.2 Design Requirement of the proposed Vaccine Laboratory and operation Specifications

The vaccine laboratory which is going to be built at pre-owned MOH land would be designed and operated in accordance with guidance for vaccine laboratories established by reputable international organizations (CDC, 1999; WHO, 2004). The laboratory will be tested for verification that the design and operational parameters have been met prior to operation. Annual verification of vaccine laboratory is recommended by the WHO biosafety manual and CDC BMBL and the laboratory layout. Hence, the proposed vaccine laboratory will be annually verified using the checklist in Annex IV.

5.2.1. General design and safety requirements for the Vaccine laboratory

This lab will contain all premises required for performing food and pharmaceuticals quality control testing and related research activities. It should be noted that the use of chemicals and other potentially hazardous compounds including test microorganisms as well as laboratory animals separates laboratories from other types of building spaces. Protecting the health and safety of laboratory and building occupants as well as environmental protection from laboratory waste must be taken as the primary concern during designing. Comfort and energy-efficiency are also of considerable importance. The space temperature and humidity must remain comfortable for occupants while maintaining an appropriate temperature and humidity requirement for chemical processes. At the same time, the facilities shall be under pressure to minimize operating costs.

From safety point of view, the designer should give special emphasis to Toxicology, microbiology and biological testing laboratories as they require a high containment of biological entities andwastes as well as chemical store and testing rooms for anti-cancer andcytotoxic pharmaceutical products.

Therefore, a host of criteria, including safety, comfort, and energy efficiency, must be considered at the very initial stage in order to determine the optimal design. Sample storage areas shall provide sample reception, secure and appropriate storage conditions for incoming, under analysis, stability study rooms/chambers, and retention samples.

The design shall indicate central building management system and up to date mechanisms for access control system to all laboratories so that it will be restricted to authorized personnel. Laboratory rooms and collaborative spaces should be designed to support human interaction and encourage cross-pollination among relevant disciplines. Work areas should be flexible, inviting, stimulating, open spaces rather than cubicles where possible, should be filled with energy and activity. The laboratory buildings should adaptable, because the way quality control is conducted may change, laboratories need to be able to adapt to these changes. The design shall provide setting up of a flexible and adaptable framework for the QC laboratory buildings. Such setting up shall allow individual laboratory groups to rearrange their labs to suit their needs and be able to allow each lab space to be configured for plug-and-play operations. The design shall consider possibility of laboratory scientists reconfiguring their labs with minimal effort and allow for lab floors to be subdivided and sublet with ease. Building height and number of floors shall consider

the type and amount of toxic chemicals used in the labs and restrict floors without chemicals accordingly. The floor to floor height of the buildings shall ensure adaptability and usability. The designer shall consider laboratory lean management process and current advances while designing different rooms of the laboratory. Spaces should be capable of being completely reconfigured with less effort. Re-circulating air and non-recirculating air areas, exhaust driven areas (fume hoods), and supply driven shall optimize air change rates, duct air speeds, system pressure drops as well as fan energy consumptions.

General Program formulation, room program, functional Relationships and room loading for the building of vaccine laboratory

- Current Working polices andprevious relevant studies has to be incorporated to the designs
- Design should be as per acceptable standard requirements for Lean laboratory design
- It should Envisage work procedures in the laboratories
- Scope of the services should be taken into consideration

Room program for each division functions of the laboratory

- Type and description of rooms, departments, and functional Units.
- Number of rooms and room areas.
- Outdoor and indoor Relationships.

Functional Relationships between the different laboratory rooms

- Areas that require major focus in the overall functions
- Functional relationships in terms of desirable, mandatory, acceptable, and forbidden relationships of the functions.

Room loading for each functional room of the laboratory

Space requirement and special features of each laboratory

The space requirement of each division/laboratory differ as result of the type of test it carries out, types of test items they handle, number of analyst and technician, and number and type of equipment used to carry out the specified tasks. Based on these factors the proposed space requirements and the special features required in constructing the laboratory for each division are described below.

5.2.2 Space Requirement and Special Features in Pharmaceutical Microbiology Laboratories

The microbiology laboratories design should be arranged so as to provide maximum protection of the operator, provide appropriate level of cleanness, minimize risks of cross-contamination, by the 'no way back' layout principle, in view of the following areas:

- Changing/Gowning rooms
- Separate material & personnel entry
- Media and equipment preparation (including sterilization)
- Sample storage (day store)
- Sample preparation
- Samples examination rooms (microbial limit test, LAL test, Microbiological Assay etc)
- Incubation area
- Maintenance of reference test organisms.
- Sterility testing
- Decontamination
- Area for washing (after decontamination)
- Emergency exits with Safe corridor
- Buffer zones
- Vaccines and Biologics QC testing

The design shall also consider appropriate ventilation and suitable temperature requirements for each room. It shall reflect on reduction of contamination by:

- Smooth surfaces on walls, ceilings, floors.
- Coved/concave joints between the floor, walls, and ceiling.
- Minimal opening of windows and doors (provided with Air locks & interlocked doors)
- Sun shades.
- Fluid conveying pipes not passing above work surfaces unless placed in hermetically sealed casings.
- Dust-filtered air inlet for the ventilation system.
- non-manually controlled and separate hand-washing arrangements.

- Ceilings shall have a smooth surface with flush lighting and no suspended ceilings and hanging lights.
- The temperature of the rooms must be maintained in the range of 16-22^{o}C.
- A positive pressure gradient supplied by high efficiency particulate air filter (HEPA) must be maintained between the different grades of clean rooms (A/B, C and D) as well as the changing room and the wash zone
- The sterility test room must provide Grade B background environment and should be access controlled.
- Must have continuous supply of water, electricity, compressed air, and vacuum
- There must be a separate hand washing arrangements, non-manual (sensor controlled)
- The design for the premises of microbiology laboratory must contain two different areas:
    - Ancillary premises: these include entrances-controlled access to the microbiological laboratory, offices, cloak rooms and, storage rooms, etc.
    - Test premises: these include areas where specific microbiological testing and associated activities are carried out.

Specific Rooms

1. **Air shower:** A HEPA filtered air must be designed in such a way to provide air shower at the 1st entry to the microbiology lab.
2. **Microbiology lab Changing rooms:** The room must accommodate a cabinet /locker with shelves for changing of cloths and gowns before entrance into the microbiology laboratories, there shall be hand wash basin. The doors of the changing room should be interlocked and provide appropriate passage control at the entrance to the laboratory`s ancillary and testing areas.
3. **Microbiology Sample storeroom:** The room is for storage of under test samples and temporary storage of samples after completion of analysis. The room must have facilities to control the temperature and humidity of the room.
4. **Media Preparation room:** The laboratory will have a media preparation room near the sample storage room. The room must accommodate at least two benches so as to accommodate equipment like Balance, pH meter, autoclave, and shelves for Medias and glassware etc. There must be a centrally located emergency eye and face wash fountain. It must be well ventilated, and the balance shall be provided with dust suckers.

5. **Microbiology Sample preparation Room:** This room must be located near sample storeroom and it accommodates apparatuses used for sample preparation, homogenizers, vortex mixers, heating mantle, water bath etc.
6. **Main Microbiology room:** The room must be located next to the sample preparation room. The room accommodates equipment's like biological safety cabinets, Horizontal laminar air flow cabinet, zone reader, colony counter, spectrophotometer, turbid meter etc. In this room the analysts perform microbial assay, LAL test, Preservative efficacy test, microbial limit test and in-vitro vaccine quality control test. The room must have a small balance room for weighing of sample and reference standard. On top of each bench, there must be shelves to keep chemicals and reagents. There must be a centrally locating emergency eye and face wash fountain.
7. **Second Changing room for entry to sterility testing:** This is to minimize the risk of contaminating sterility testing room. The room must accommodate appropriate lockers with shelves for changing gowns before entrance into the microbiology laboratories. The doors of the changing room should be interlocked and provide appropriate passage control at the entrance to the sterility testing room.
8. **Sterility test room (2 rooms):** The room shall be equipped with horizontal Laminar Air Flow Cabinet, Peristaltic pump, suction pump, and bench, filtration manifold. The room must be constructed with HEPA filter with a positive pressure to the outside of the room (minimum Class B) and provided with Magnhelic pressure gauges.
9. **Vaccine QC testing room (40 Sq.m):** The laboratory should be appropriately designed and should consider the suitability of construction materials to enable appropriate cleaning, disinfection and minimize the risks of contamination. There should be sufficient space for all activities to avoid mix ups, contamination and cross-contamination. There should be adequate suitable space for samples, cellcultures, media, testing and records.
10. **Decontamination room:** The room accommodates items for decontamination, autoclave, cabinet with shelves, oven etc. It shall be provided with appropriate ventilation to extract the bad smell produced during contaminating culture media with microbiological growth
11. **Washing room (4 sq. m):** The room must accommodate glassware washing machine, cabinet with shelves, oven etc.

5.2.3 Space Requirement and Special Features in Physicochemical Laboratories

The design for physico-chemical testing laboratory facilities should consider the following:

Designed to suit the functions and operations to be conducted in them

- Separate rest and refreshment rooms which are easily accessible and appropriate for the number of users.
- The laboratory design shall take in to account the types and number of equipments in the laboratory and possibility of increase in number and types (for space, electrical, water supply and drainage /sink requirements)
- It should indicate appropriate locations and space requirements for fume hoods, isolator (glove boxes), and other facilities for handling and testing of toxic & carcinogenic medicines.
- The environmental conditions, including lighting, energy sources, temperature, humidity and air pressure, are to be appropriate to the functions and operations to be performed.
- The design shall indicate necessary measuring devices for monitoring environmental conditions such as pressure gauges, digital thermometers etc. where necessary (cold rooms).
- The design shall provide appropriate exhaust system to avoid or minimize exposure and contamination while weighing and manipulate solid chemicals, powdered andvolatile test items especially for highly toxic substances, including genotoxic substances.
- The design shall provide appropriate means for the safe disposal of all types of waste laboratory wastes including toxic waste (chemical and biological), reagents, samples, and solvents.
- The design shall include in securely locked storage facilities for samples, reference standards and chemicals under refrigeration (2–8°C).
- The types of construction materials including doors of testing rooms, stores for chemicals andtoxic or flammable reagents should be considered during designing.
- Pipes for various gases (acetylene, compressed air, vacuum, and various carrier gases) supply anddistribution from an external gas store should be considered.
- Control access and entryway to the laboratory.
- Doors must be self-closing andself-latching and opening on to exit corridors.
- Doors within interior partitions shall be self-latching.
- All doors opening onto the exit corridor and within interior partition must be provided with view panels.
- All doors must be fire resistant (90 minute), the time depends on the type of the room.

- All view panels shall be ± 7.5cm x 82.5cm and shall be 6mm wire glass in steel frames.
- A glassware cleaning sinks shall be of appropriate size based on the volume of work and type of material suitable for the items to be drained.
- Interior laboratories and /or windowless laboratories shall be provided with emergency lighting.
- Placement of "supply air" and "exhaust air" vents must be located to avoid short, circuited air movement patterns.

The physicochemical rooms should have work areas to ensure safe and conducive working conditions. The laboratory building is proposed to include the following major areas:

- Sample receipt area
- Sample storage areas (incoming samples & retention samples rooms)
- Reference storage room
- Balance room
- Main physicochemical laboratory
- Instrument rooms
- Hot zone
- Chemical storage room
- Washing room

To have the desired work area it should be designed and constructed with the following general requirements and space requirements.

Specific Room requirements

i. **Sample receipt area (Reception)**:

   The workspace will have sample recipient area, which has sufficient space to serve at least for two people at the same time this area must be situated immediately before the access control door at the entrance gate to the medicine quality control laboratory.

ii. **Pharmaceutical Sample storage rooms**

   The work area shall have sample storage area that is nearer to sample receiving area right after the access control gate. And this room shall have means of controlling (regulating) the temperature and humidity and this room will have internal partition to accommodate retained samples.

iii. Condom and medical device storage room

The temperature and humidity of this room should regulate and this room will have internal partition to accommodate retained samples.

iv. Reference substances storage room

The reference substance storage areas shall be two separate rooms one of it with about 6Sq.m area with control room temperature and humidity and the other one is about 4Sq.m area with control temperature in the range of 2-8 degree.

v. Main medicine physicochemical laboratory Hall

This is a central island for sample preparations/wet chemistry, for mobile phase preparation and for placement of common instruments such as: pH meter, rotary evaporator, shakers, Kjeldahl apparatus, water baths, heating mantle, and melting point. This room shall be located in central position for easy access to the instrument rooms, balance rooms, fume hoods, offices etc. so that, the analyst will not walk very far to accomplish any given task. There should be an exhaust or purge fan system. These premises must be protected as required from excessive conditions, such as heat, cold, dust, moisture, steam, noise, vibration and electromagnetic disturbance or interference. The room will have at least the following facilities.

a. Centrally located working benches/experimental table, top surface of which is resistant to corrosives /acid resistant, and made of nonflammable, chemical resistant material. The benches should be fitted with cupboard.
b. On top of each bench there should be shelves to keep reagents and chemicals.
c. Each bench should be fitted with electric sockets 220V and 110V.
d. Each bench should be fitted appropriate sinks with a running water, gas supply, drainage system, vacuum system, and, eye and face wash fountain.
e. Design shall locate areas within the lab where Emergency showers, fire extinguisher should be installed.
f. The following facility
g. Stability chamber (it needs)
h. Fume hoods (general purpose and perchloric acid)
i. Automatic titrator (needs about 3 Sq.m) will be placed in this hall (wet chemistry) provided that the Aisles/passageways between these facilities and the benches in

the main hall maintained not to be less than 1meter.in addition it is recommended that the automatic titrator placed close to the fume hoods.

vi. Medicine physicochemical lab Balance room

The medicine physicochemical lab shall have two rooms of 4.5 Sq.m wide at appropriate locations in the main laboratory hall facing each other. It should be fitted with sliding door. The balance room shall not be far from sample preparation room by more than 2-meter distance. The room should have vibration free bench (fixed benches is preferred). It must be free from having direct contact with air turbulence. Wash basin, water taps must not be installed. It should have power line circuit for each balance in order to avoid two or more balance from sharing the same power line circuit.

vii. Medicine physicochemical lab Instrument rooms: -

Instruments can be organized/ grouped based on the type of work employed or by equipment grouping. The room where instruments are placed in shall be separated from the wet chemistry by interior partition.

a. **Instrument room:** The temperature and humidity of the room for these instruments should be regulated as need of the instruments.
   I. UV –Vis spectrophotometers,
   II. FTIR,
   III. Polari meter, refract meter, particle counter.

b. **Instruments room 2:** This room should be equipped with gas (acetylene, butane, and oxygen), nitrogen and hydrogen supplying lines. Ventilation (vent duct) system should be installed.
   - Atomic absorption spectrophotometer
   - Flame photometer; Gas chromatography (GC), Gas chromatography –Mass Spectroscopy (GC-MS)
   - Differential scanning calorimeter,

c. **Instruments room 3(40 Sq.m.):** This room must have means of regulating temperature and humidity and it should be at least 40 Sq.m wide and should have gas lines for nitrogen.
   - HPLCs
   - HPLC-MS

d. **Instruments room 4 (30 Sq.m.):** This room will be about 30 Sq.m. wide and will be equipped with the following equipment.
   - Dissolution apparatus
   - Disintegration apparatus
   - Hardness and friability apparatus

e. **Instruments room 5 (16 Sq.m):** This room will be a chromatographic room consisting of a 16 Sq.m for the TLC, paper and column chromatography and adjacent 2.5 Sq.m dark rooms.

5.2.4 Vaccines & Biological testing lab

i. Medical device testing room

The temperature and humidity of the room should be controlled /regulated. The walls should be clad with soundproof materials.

The area for these rooms should be 120 Sq.m. and will be equipped with the following equipment's.

- Inflation tester
- Electronic leak tester
- Tensile strength machine
- Water leak tester
- Package integrity tester
- Width and length measuring devise
- Other equipment's for QC of other medical devices.

ii. Medicine lab Washing room (40 Sq.m): -

This room will be used for washing and drying glassware's as well as serve to prepare distil and deionized water for the need of the laboratory and it needs about 40 Sq.m area. This room should be fitted with all necessary tubing and fittings as well as appropriate sinks and drainage lines should be installed. The room will be equipped with the following equipment's.

- Washing machines
- Single and double distiller
- Water purifiers/Deionizer
- Drying oven

- Shelves

iii. Medicine lab Chemical day storage room (16 Sq.m.)

This 16 Sq.m room will be used for storing chemicals and reagent taken from the main store area and that will be used for day-to-day purposes. The Storage rooms should be separate from rooms or areas containing the test systems and have adequate ventilation. It must have means of regulating temperature and humidity. Furthermore, it should have a smoke alarm and fire-resistant cabinets for flammable solvents. They should be built adequately to ensure stability and safe storage of chemicals. Chemical shelving should be secured to the wall and floor and the shelves must have lips to prevent bottles from sliding off.

5.2.5. Space Requirement and Special Features in Toxicology Laboratory

The toxicology laboratory should be constructed to fit for the desired purpose. It must be designed with the following main separate areas:

- Sample receipt area
- Sample storage room
- Chemical store room
- Main toxicology laboratory hall
- Instrument rooms
- Balance room
- Washing and decontamination room
- Toxicity test room
- Animal housing room
- Animal breading room
- Feed storage and preparation room
- Offices

To have the desired work area it should be designed and constructed with the following general requirements.

Special features/requirement in toxicology laboratory

- Control access and entryway to the division laboratory
- The animal housing, breeding and testing room should be free from Vibration

- The animal housing, breeding and testing room should have eye wash fountains appropriate sinks and emergency showers.
- The animal housing, breeding and testing room temperature, humidity and air- change rate must be carefully controlled.
- The animal housing, breeding and testing room heating, ventilation and air conditioning system must also be capable of maintaining the full requirements for all anticipated animal types and populations usually temperature range of (18^{o}c - 25^{o}c) and humidity between (40%- 70%).
- Design shall provide Optimum air quality in laboratory animal facilities whichis essential for the general health and well-being of researches, animal caregivers, and the animals, as well as for the integrity of the studies
- The animal housing, breeding and testing rooms should have wash systems, animal waste drainage and drinking water system.

Toxicology laboratory Rooms

1. **Sample reception area:** This room must be placed just before the entrance of toxicology laboratory.
2. **Sample storage room:** This room must be constructed in such way that it's the temperature, humidity; air change rate could be controlled and monitored on continuous bases. It should be equipped with refrigerators and shelves. Working area should situate it near
3. **Chemical store room:** It will be used for storing chemicals and reagents for daily uses. It should be equipped with refrigerator and shelf and also should be situated near by working area.
4. **Main toxicology laboratory hall:** This laboratory should be situated in front of office having instruments room on the opposite side of office. In this room two major activities will be performed (Analytical toxicology, General toxicology, and pharmacology). This lab will be equipped with the followings equipment: Incubator, Oven, Microscope, Refrigerators, pH meters, centrifuge, bio-chemicals safety cabinets, general-purpose hood and organic solvent extraction hood. The room will have at least the following facilities
   a. Centrally located working benches/experimental table, top surface of which is resistant to corrosives /acid resistant, and made of nonflammable, chemical resistant material.
   b. The benches should be fitted with cupboard.

c. On top of each bench there should be shelves to keep reagents and chemicals.

d. Each bench should be fitted with electric sockets 220V and 110

e. Each bench should be fitted appropriate sinks with a running cold and warm water, gas supply, drainage system, vacuum system and, eye and face wash fountain

f. Emergency showers, fire extinguisher should be installed.

5. Instrument room

It will have the following rooms.

a. Instrument Room: The Temperature and humidity of this room should be regulated. This room will be equipped with the following equipment's.

→ ELISA machine with well washer, Chemistry analyzer and gel electrophoresis

→ HPLC, Spectrophotometer (double and single beam) FTIR, fluorescence-spectrophotometer

b. Instrument Room: This room should have gas lines such as compressed air, nitrogen, helium, hydrogen, and acetylene gas. And it will be equipped with the following instruments:

→ GC, GCMS, AAS.

c. Instrument Room: This room will be having TLCapparatus with scanning device. In this room there should be dark room separated from it with internal partitions.

6. Balance room: This room will be placed inside main toxicology laboratory hall separated from the rest of the area with internal partition. And it should place far away from equipment generating heat, vibration, current air and moisture. The door should be sliding. The bench should be stable and vibration resistant

7. Washing and decontamination room: This room should be situated next to main laboratory on the opposite side of toxicology laboratory gate.

It will have the following Equipment's:

- Washing machine
- Single and double distiller machine
- Water purifier/Deionizer
- Oven
- Autoclave
- Cabinet with shelves

8. Toxicity test room:

In this room different species of animals will be kept during toxicological tests; the Room will be outfitted with shelves, which are suitable for each placement of cages for each species as well as appropriate ventilation system.

9. Animal housing room:

This room will be used for housing about five animal species. The animals will be kept in this room after breeding and until the need for test are raised. Window must not be available in this room, and it should have proper ventilation, temperature and humidity control system.

10. Animal breeding rooms:

This room will be used for breeding different animal species.

11. Animal feed storage and preparation room:

These two rooms have to be placed sides by side being far away from animals' room (Breading, housing, and testing rooms). The feed preparation room will have grinding mill and pellet making machines.

12. Quarantine and treatment room:

This room should be near to the bio-toxicity room

13. Changing room and shower room:

This room should be on the immediate vicinity of bio-toxicity and breeding room

14. Lab animals' attendants Offices:

These office areas must be separated from the laboratory work area, animal breading and feed preparation by anon-combustible transparent barrier. It should be provided with appropriate ventilation.

5.2.6. Space Requirement and Special Features in Food Quality Control Laboratory

The Food Quality Control laboratory rooms should have work areas to ensure safe and conducive working conditions. Access and entryway to the division laboratory should be controlled.The Food Quality Control laboratory shall have at least the following areas.

- Reception area
- Sample storage room

- Balance room
- Main food Chemical laboratory hall (Wet chemistry/Working area equipped with hoods)
- Aflatoxin, Veterinary drug and Pesticide residue analysis room
- Instrument room
- Washing room
- Chemical storage room
- Offices

Food QC lab Rooms

i) Reception area(30 Sq.m)

The division will have sample recipient area. This area must be suited immediately before the access control door that is entrance to the main working area of the food QC lab.

ii) Sample storage rooms(40 Sq.m)

This room should be nearer to sample receiving area right after the access control gate. And this room shall have means of controlling (regulating) the temperature and humidity. There should be two separate sample storage rooms with an area of 30 Sq.m and 10 Sq.m. The larger room should be internally partitioned and used for storing incoming samples as well as for storing retained samples after analysis while the second should be dedicated for pesticide residue analysis samples.

iii) Balance room (4Sq.m)

The room shall be placed inside or immediate adjacent to the sample preparation (main food testing hall) separated from other space with internal partitions. It should be fitted with sliding door. The room should have vibration free bench (fixed marble bench is preferred). It must be free from having direct contact with air turbulence. Wash basin, water taps must not be installed. It should have power line circuit for each balance in order to avoid two or more balance from sharing the same power line circuit.

iv)Food sample preparation Rooms

The room shall be part of or be placed adjacent to the main food testing hall separated from other testing space with internal partitions. The room should have vibration free bench (fixed marble bench is preferred). Wash basin, water taps need to be installed. It should have power

line circuit appropriate for homogenizers, mixers grinders and other apparatuses used for food sample preparation.

v) Main Food QC testing laboratory hall

This is a central island for sample preparations/wet chemistry. This room shall be equipped with hoods and located in central position for easy access to the instruments rooms. In this room there should be an exhaust or purge fan system that always provides sufficient fresh air circulation. These premises must be protected as required from excessive conditions, such as heat, cold, dust, moisture, steam, noise, vibration and electromagnetic disturbance or interference. It will be equipped with the following major instruments:

- Digester and distiller for protein analysis, Fat extractor, ovens, furnace, automatic titrators, heating blocks etc.

The room will have at least the following facilities.

- Centrally located working benches/experimental table, top surface of which is resistant to corrosives /acid resistant, and made of nonflammable, chemical resistant material.
- The benches should be fitted with cupboard.
- On top of each bench there should be shelves to keep reagents and chemicals.
- Each bench should be fitted with electric sockets 220V/110V
- Each bench should be fitted appropriate sinks with a running cold and warm water, gas supply, drainage system, vacuum system and, eye and face wash fountain
- Emergency showers and fire extinguisher should be installed.

vi) Pesticide Residue samples preparation laboratory (20 Sq.m)

The room shall be placed adjacent to the main food testing hall separated from other testing space with internal partitions. The room should have vibration free bench (fixed marble bench is preferred). Wash basin, water taps needs to be installed. It should have power line circuit appropriate for safety cabinets homogenizers, mixers grinders and other apparatuses used for food sample preparation. The room shall be provided with appropriate ventilation system.

vii) Pesticide residue analysis room

This room shall be adjacent to the main food quality control laboratory hall or nearer to it. The room will have all necessary facility as mentioned in main pesticide laboratory hall that are necessary for preparing sample.

viii) Instrument room

This room can be used in common with the toxicology laboratory. This room should have gas lines such as compressed gas, nitrogen, helium, and hydrogen. It will be equipped with the following major instruments:

- GC, GC-MS-MS, HPLC, LC-MS-MS, Atomic absorption, ICP-MS and UV-Visible spectrophotometer and other similar equipment.

ix) Chemical day room

This room will be used for storing chemicals and reagent taken from the main store area and that will be used for day-to-day. The Storage rooms should be separate from rooms or areas containing the test systems and have adequate ventilation. It must have means of regulating temperature and humidity. Furthermore, it should have a smoke sensor alarm and fire resistant cabinets for flammable solvents. They should be built adequately to preserve identity, concentration, purity, and stability, and ensure safe storage of hazardous substances. Chemical shelving should be secured to the wall or floor and the shelves must have lips to prevent bottles from sliding off.

5.2.7. Drug Evaluation and Research Laboratory

This laboratory will share most of the testing rooms and instruments of other testing labs. However, it requires the following dedicated rooms with the following functions:

- Analytical method related research, Pharmacology, Bio-pharmaceutics and Stability studies

It will be equipped with the following major instruments:

- Capillary Electrophorosis & automated Solid phase extraction systems
- Automated flow-cytometery
- Cell counters and colony counters
- Chemistry analyzer,
- X-ray crystallography
- Apparatuses for biological specimen samples preparations
- Apparatuses and equipment for enantiomers, chiral compounds, adulterants and impurities analysis

5.3. Specifications for Floors, Walls, and Ceilings

The vaccinelaboratory will be constructed using concrete footing and stem walls with concrete slab-on-grade floors. Walls would be steel stud framed and roof construction would consist of metal decking over steel bar joists. The exterior walls would have an application of stucco and the painting of the building would be visually consistent with surrounding structures.

The lab floors will be impermeable to liquids, monolithic/seamless, or have welded seams. Floors must be easily cleaned, with chemical-resistant flooring (vinyl, or epoxy with fiberglass reinforcement) with a slip-resistant, smooth, hard finish. For monolithic floors, either a 100-mm-high, readily cleanable, integrally coved sheet flooring base, or a readily cleanable, 100 -mm-high,vinyl or rubber base should be used. For epoxy floors, if silicone sealants are used for penetrations, the silicone must be applied after the epoxy has been installed. Floors would be monolithic and slip resistant.

The walls of the lab must be durable, washable, and resistant to detergents/disinfectants (masonry, gypsum board, fiberglass-reinforced plastic, etc.). Walls will also be painted with durable glossy acrylic or epoxy paint. For epoxy paint, if silicone sealants are used for penetrations, the silicone must be applied after the epoxy has been installed. Wall/ceiling penetrations will be kept to a minimum and sealed with non-rigid, non-shrinking silicone or latex sealant. For fire rated walls, sealant will be applied before stopping.

The ceiling of the vaccine lab must be washable and resistant to detergents/disinfectants. Ceiling has to be painted with durable glossy acrylic or epoxy paint. If silicone sealants are used, the silicone will be applied after the epoxy. The ceiling must be of monolithic construction (i.e., gypsum board, not removable tiles). The ceiling must be high enough over Class II A2 biological safety cabinets (BSCs) to allow a canopy/thimble connection or the opening of canopy/thimble door(s). Ceiling height would be at least 10 feet to allow 14 inches of clearance above BSCs. All penetrations in floors, walls and ceiling surfaces would be sealed, or capable of being sealed to facilitate disinfection, to aid in maintaining appropriate ventilation system air pressures and to keep pests out.

Justification: Due to the highly chemical and pathogenic nature of the microorganisms frequently encountered in such laboratories, the efficacy of disinfection and decontamination procedures must be ensured without compromising the integrity of the facility. Surfaces that absorb water or degrade in the presence of chemical disinfectants are not suitable for an

environment that will be repeatedly exposed to both. Sealed surfaces and floor coving are recommended to reduce the number of cracks or crevices that may harbour microorganisms during application of a disinfectant or decontaminant.

Doors

Lab doors to be installed for this lab would be self-closing and lockable. Doors need to be open inward slide open. If sliders are used, they must be made of safety glass and a trackless design should be considered. Door between anteroom and corridor must have door sweep for pest control. Door openings should be sized to allow the passage of large equipment. Wall-door frame connection would be made airtight at time of frame installation. Doors and frames will be of solid finish construction, with the required fire ratings and include panic-hardware, hardware appropriate for high-use and kick plates. Doors would be coated metal which is chemical resistant. Methods for restricting access to only those individuals with demonstrated need, proper clearance, and training must be in place. Notices will be posted outside the first door to notify potential entrants of the hazards contained within and measures they must take to protect themselves.

Justification: The risk of potential exposure in high containment spaces and the regulatory requirements for access to Select Agent spaces require that only those individuals with demonstrated need and proper preparation be allowed access to high containment spaces.

Interlocking double-door access is necessary to ensure that, at no time, is the interior of the laboratory exposed to any common area.

Windows

Windows (safety glass, permanently closed, sealed with silicone or latex sealant) would be installed so that the interior of the adjacent room, except change rooms and restrooms, is visible. Windows must not allow viewing from public areas. Interior sills will be sloped away from windows for ease of cleaning or to minimize dust collection.

Justification: To maintain proper pressure differential and directional airflow, to prevent egress of aerosols, particularly during space decontamination, to the surrounding spaces or environment, and to assist with pest control.

Eyewash/Safety Shower

Emergency eyewash will be in each lab room. A combination emergency eyewash/safety shower unit must be in near proximity to places if personnel are exposed to splash hazards (determined during programming). Emergency eyewash and emergency eyewash/safety shower units would be sited and installed.

Justification: Numerous microorganisms are infectious if exposed to the mucous membranes around the eye. Therefore, eyes shall be flushed thoroughly after splashes and exposures to the eyes.

Plumbing

All penetrations must be perpendicular to the surface and must be sealed to be gas -tight. Penetrations must also be sealed with non-rigid, non-shrinking, silicone or latex sealant. For fire-rated walls, sealant will be applied before stopping. All pipes into the vaccine lab would be secured to prevent movement. Fixtures must be resistant to corrosion of bleach and other disinfectants. Back-flow prevention devices will be installed on all faucets (including industrial water). All pipes will be identified by using labels and tags. Water supply control will be located outside the containment area. Plumbing should discharge directly to a sanitary sewer.

Sinks

Hand washing sinks in the lab will be available in each room near exits. Sinks will be hands -free. Infrared sensors are preferable but may not be suitable for all laboratories. In cases where infrared sensors cannot be used, knee-operated sinks are preferable to foot-operated. Each sink will have chemical-resistant traps (for disinfectants), a coved backsplash, a hot-cold water and pre-mixing faucet. Hand washing sink will be accompanied by a paper-towel dispenser and a hands-free soap dispenser mounted within easy reach.

Justification: Numerous pathogenic organisms can be transferred by hand contact to mucous membranes or other surfaces in the laboratory. It is extremely important to wash hands often and before leaving the laboratory. For the latter reason, the sink shall be located close to the egress.

Autoclave

An autoclave in the lab will be equipped with interlocked doors. Decontamination cycles would be determined during programming; gravity and liquid cycles are typical. Appropriate autoclave size should be determined prior to purchase. The body of the autoclave will be located outside containment to provide easy access for maintenance. Enough space adjacent to the contaminated

(input) door must be present for waste collection. Control panels should be located internal and external to containment. Bioseals or other equivalent means would be used to create a seal at the wall. The floor under the autoclave would be monolithic, seamless, or heat-sealed, coved and water tight. Floor penetrations, if essential, would have a water and gas-tight seal at the monolithic floor. Walls and hard ceiling will have epoxy paint. Exposed pipes would be insulated. The autoclave should be seismically anchored. A curbed corrosion-resistant basin would be installed to prevent leakage. A canopy hood will be provided over the exit door of the autoclave to contain heat and steam. The installation will be signed off by a professional engineer. The autoclave room must have a minimum of 10 air changes per hour.

Fire Safety and alarms

Fire alarms must be clearly audible above ambient noise. A wall-mounted ABC Dry Chemical fire extinguisher must be mounted near the exit door of the anteroom. Laboratory-safe refrigerators or metal flammable cabinets will be used to store flammable/combustible materials. Alarms are provided for: fire hazard, ventilation failure, differential pressures below 0.05" wg, -80°C ultra-cold freezers and intrusion detection systems. Alarms will be connected to the building control system and to campus public safety department. Alarms should be audible and visible throughout the laboratory. Alarms would be differentiated from each other so that each can be easily identified. Alarms will be on UPS power.

Vacuum System/Pump

Vacuum lines will be protected with liquid disinfectant traps and HEPA filters, or their equivalent. Filters will be replaced as needed. An alternative is to use portable vacuum pumps (also properly protected with traps and HEPA filters). If an individual vacuum pump is used, it would be located in the laboratory. Noise and maintenance issues would also be addressed.

Electrical requirements

In this vaccine lab, an emergency power will be provided for HVAC (including controls), alarms, emergency lighting, biological safety cabinets, storage freezers and incubators. UPS power would be provided to alarms, and when possible, to biological safety cabinets. An independent circuit would be provided for each biological safety cabinet. Wall/ceiling penetrations would be kept to a minimum and will be sealed with non-rigid, non-shrinking silicone or latex sealant. For fire-rated walls, sealant will be applied before stopping. Junction boxes would be cast and/or sealed airtight (e.g. closed cell foam compatible with gaseous paraformaldehyde). Light fixtures

are surface or pendent-mounted. Circuit breakers will be located outside containment and are labeled.

Heating, Ventilation and Air Conditioning (HVAC) System requirements

The HVAC system would be Constant Air Volume (CAV). Variable Air Volume (VAV) is not recommended. Electronic direct digital controls are used to manage the system. Recirculation of exhaust air will not be allowed. A dedicated exhaust system is required. The outside exhaust must be dispersed away from occupied areas and air intakes, or the exhaust must be HEPA-filtered. Locating the exhaust stacks on the roof and discharging upward at a velocity greater than 3,000 fpm is recommended. An exhaust HEPA is required (see HEPA filter section). The need for a redundant exhaust fan would be determined by users, to allow continuing work. Air supply and exhaust system capacity should be ≥ 125% of the laboratory's requirements to provide for future adaptability and flexibility. The HVAC system creates directional airflow drawing air from rooms/areas of low hazard into rooms/areas of higher hazard. Inward directional airflow will be maintained by providing 15% more flow of exhaust airflow than supply air, and sufficient to maintain the differential pressure between rooms in 0.05-0.20" Wg range. The air balance accommodates biological safety cabinet canopy/thimble connection or Class II type B2 cabinet exhausts requirements. Inward directional airflow will be verified before entry. Devices to indicate/confirm directional airflow into the laboratory (e.g., 0 - 0.20" Wg magnehelic gauges, digital differential pressure monitors or both) will be installed. If exhaust system fails, the lab must not become positively pressured. Whenever possible, the supply and exhaust fans will be electrically interlocked. Exhaust ductwork will not be positively pressurized.

Supply and exhaust dampers would be gas-tight and closable from outside the facility to facilitate decontamination with gaseous paraformaldehyde. Local visual and audible ventilation system failure alarms are required for laboratory personnel. Air supply diffusers will be located so that airflow at the biological safety cabinet face is unaffected (laminar diffusers preferred). Ductwork would be located external to the laboratory; if exposed in the laboratory, ductwork is clear of walls to allow for cleaning, maintenance, and leak testing. Ductwork will be gas-tight 316 stainless steel up to the HEPA filter. All ducts will be constructed in a leak-tight manner with seams and joints usually welded airtight. The biosafety officer will determine if exhaust ductwork is to be welded. If the exhaust ductwork is welded, welded joints will be recommended for all connections except for the damper(s) (use flange and bolt connections for quick change-out in the future). Coil units (for supplemental cooling) should not impact cleaning or provide a

breach of containment. Elbows will be limited whenever possible to reduce the amount of background noise generated.

Justifications: Recirculate air is not permitted to eliminate any possibility of potentially contaminated air entering other building spaces such as in the event of a failure in one of the containment systems. Negative air pressure between rooms produces the directional airflow necessary to contain potentially contaminated aerosols, 0.05" WG is typically within the operating range of most HVAC components and sensors and provides containment during common events such as doors opening and personnel ingress/egress. Positive pressure ductwork inside occupied spaces is not permitted to eliminate any possibility of potentially contaminated air entering building spaces in the event of a breach or failure in the ductwork. To maintain directional airflow under failure scenarios, control valves must be in place to compensate for changing system pressures. With airflow offset control, doors must be designed to allow air to flow into room to maintain directional airflow. As an option, if doors are too tight barometric damper in door or wall of room can be provided.

HEPA filter

The HEPA filters in this lab will be "bag-in, bag-out," and the housing accommodates gas decontamination and filter testing (gas-tight dampers and housing). In order to facilitate filter change-out, the HEPA filter housings will not be more than five-feet high. When HEPA filters are installed, a magnehelic gauge or other pressure-monitoring device will be put in, with the display placed in the most accessible location that is practical to measure pressure drop across the filters. A HEPA could be required on the autoclave exhaust, ultracentrifuge vent and sewer vent. HEPA filters must comply with DOE-STD-3020-97 (or latest edition). Arrangements will be made to permit periodic leak testing of exhaust system HEPA filters. The system also needs comply with ASME AG-1.

Justifications: Enhanced engineering controls, such as HEPA-filtered exhaust, are necessary to prepare the space for the potential need in future research. Providing HEPA-filtered exhaust (or the capability to do so, e.g. installing HEPA filter housings but not using HEPA filters until required) affords greater flexibility and adaptability of the Vaccine laboratory spaces.

Laboratory Furniture and Casework

Furniture and casework in the lab will be sturdy and capable of supporting anticipated loading and uses. In addition, they will be spaced so that areas around and under benches, cabinets and

equipment are accessible for cleaning. Benchtops will be impervious to water and resistant to acids, alkalis, organic solvents and moderate heat. They will also have marine/drip edging for spill control. For future flexibility, modular mobile casework will be used. Ergonomic considerations will be made while designing laboratory furniture and casework (e.g., adjustable work-surface heights, selection of biological safety cabinets, adequate knee clearances for seated work, adequate toe clearances for standing work, wall cabinet heights, etc.). Fixed casework, if used, will be sealed /caulked to the walls on installation to facilitate cleaning and prevent harbourage for vermin. If fixed casework is used, it would be installed before the coved flooring so that the coving can extend up toe-kicks. For storage, closed cabinets will be used rather than open shelving. Chairs and other furniture would be covered with a non-fabric material that can be easily decontaminated. Tall or movable cabinets/shelves would be seismically anchored. To facilitate cleaning, cabinets/shelves would be made to have angled tops or be built up to the ceiling.

Justification: Activities within the vaccine laboratory could involve concurrent use of chemical solvents such as formaldehyde, phenol and ethanol as well as corrosives or other reactive chemicals. The laboratory bench or BSC work surface must be resistant to the chemical actions of these substances as well as disinfectants used to inactivate the organisms under study. Wooden orother porous or combustible bench tops are not appropriate because even finished wooden surfaces can absorb liquids or ignite in the event of a fire. Fiberglass is inappropriate since it can degrade in the presence of some chemicals; it also produces toxic smoke if burned. Laboratory furniture must not be absorbent so that it may be decontaminated effectively. Space must be left between furniture to allow for cleaning and maintenance of devices as required (i.e. biosafety cabinets).

Security

The vaccine lab access controls will be provided to record entry and exit times and dates. Palm scan, proximity card, keypad entry with codes unique to each worker, cardkey or equivalent will be used. Access to mechanical and support areas will be limited. Security measures will meet the requirements of the Select Agent Regulations if the facility is to be used for selecting agent work or storage. Security measures will meet the guidance set forth in the latest version of the CDC-NIH's Biosafety in Microbiological and Biomedical Laboratories.

5.4. Commissioning of the Vaccine Laboratory

Commissioning of the vaccinelab would be performed by a third party in the presence of the proposed vaccine lab's Biosafety Officer. The biosafety officer will furnish checklists for the containment features to be evaluated, depending on the facility design. Initially, the lab needs to pass a series of inspections and tests to meet standards that have been pre-developed, authorized, and specified in the design and construction documents before bio-hazardous agents are used. These are in addition to the desired outcomes by the commissioning team identified prior to initiation of construction activities. A properly designed and constructed bio-containment facility, including its structural and mechanical safety systems, must meet predetermined performance criteria and be operational upon completion of construction.

The integrity of the critical components of the biological containment systems will be verified by the testing and certification requirements. Certification of the vaccine lab, including structural components and safety systems, will be included as part of the overall commissioning processes normally undertaken to verify that the design and construction meet applicable standards, and that the facility can operate in accordance with the design intent. Commissioning testing must also be performed without degradation to the facility or mechanical system that is being tested. All equipment and materials would be tested/evaluated prior to installation; duplicate testing is recommended. BSCs will be certified in accordance with NSF 49 after the BSC is anchored in its final location. All HEPA filters will be tested to meet NSF 49 after installation. Integrity of seals will be demonstrated by visual inspection. The integrity of epoxy coatings may be tested using ASTM D4541 Standard Test Method for pull-off Strength of coatings using portable adhesion testers. Autoclave installation will be attested by the sign-off of a professional engineer. The autoclave will be tested to verify that it meets specified standards:

- Calibration of thermometers
- Calibration of clocks and timers
- Biological indicators are used to verify the autoclave's effectiveness

The ventilation system will be tested by:

- Ventilation ductwork and HEPA housings and must pass pressure-decay testing under ASHRAE SMACNA Standard 126-2000 (Method of Testing HVAC Air Ducts)
- Measurements of airflow at each supply and exhaust diffuser
- Smoke testing to visually verify limited turbulence at face of BSC

- Smoke testing to visually verify airflow from areas of low hazard to areas of higher hazard
- Verification that air system failure alarms (exhaust, supply, room pressure) function and annunciate properly
- Air balance report provided and verified by the biosafety officer

5.5. Qualification of the Construction Agency/Contractor for the Laboratory

Finding and hiring the right construction agency for the construction of vaccine laboratory is the key step for the success of the project. The construction agency with satisfactory qualification and expertise helps in making the containment laboratory functional and achieve standards of biosafety practices for safer working environments. The following essential qualification criteria will be considered when hiring a construction agency for the proposed vaccine lab complex: (i) the minimum average annual turnover during the last three financial years (as per their audited balance sheets) must be adequate to make sure that agency would be able to complete the project. (ii) successful and timely completion of at least one similar project (construction, testing, commissioning, and validation of vaccine laboratory) including civil, electrical, HVAC works, BMS, door interlocks, access control system, primary barrier containment equipment, decontamination system, etc. Additionally, the ability of construction agency for designing and planning, correct evaluation of architectural layout plans, men and material movement plans, zoning plans, specialized systems and services schemes, services and utilities schemes, laboratory commissioning and validation protocols, laboratory security protocols and integration of laboratory and equipment will be assessed.

5.6. Operation and Verification Procedures of the Laboratory

The EFDA Vaccine laboratory would be operated according to all guidance and requirements established by the CDC and NIH (CDC, 1999; WHO, 2004; CDC-NIH, 2020). Prior to operating the vaccine laboratory using select agents, the lab would be assessed by pertinent Ethiopian environmental regulatory organs at Ethiopian Environmental Protection Authority to verify that the vaccine lab meets biosafety level requirements for working. The lab will be functional only if it meets the minimum standards set by CDC. No select agents would be handled in the proposed vaccine laboratories without first obtaining approval from pertinent environmental and health regulatory organs in Ethiopia.

5.7. Waste Management Approaches and Standards for the Vaccine Laboratory

This section summarizes the waste management approaches and standards to be fulfilled by the laboratory. During operation of this vaccine laboratory, the disinfection after each use of the interior working surfaces of the BSCs would generate waste products. All wastes generated in the laboratory (including sample packaging materials, culture materials, Petri dishes, drugs, PPE, and associated process wastes) would leave the laboratory only after decontamination using the lab's autoclave or after being chemically sterilized. The autoclaving process involves placing waste to be autoclaved in a special container. When autoclaving occurs an indicator strip on the container will changes colour. This allows lab workers and waste management workers to be able to tell at a glance whether waste has undergone autoclaving. Performance of the autoclave is automatically tracked electronically to insure its effectiveness. This method is the same waste management method used by similar facilities to sterilize their waste.

Table 5: Wastes type and estimated waste quantity generated from proposed EFDA vaccine lab building

Lab departments	Type of solid waste generated	Estimated quantity of waste generated (kg)	Type of liquid waste generated	Estimated volume of liquid waste generated (litre)	Remarks
Microbiology lab: for medicines, biological (including vaccines), food and medical devices (some of the tests are sterility, endotoxin, microbial limit test, preservative efficacy test, microbial assay, etc.)	1. General/Other Waste: All other, non-hazardous waste				
	• Food samples	10 kg/ week	Food samples	10 L/ week	
	2. Infectious Waste: Anything that's infectious or contaminated				
	• Used culture Media	10 kg/ week	Stocks of etiologic agents	1 L/ week	
	• Contaminated towels, linens, gauze	2kg/ week		NA	
	• Personal protective equipment	1 kg/ week		NA	
	• Disposable culture Petri dishes, microscope slides and plastic pipettes	1 kg/ week		NA	
	3. Sharps & Waste like needles, scalpels, broken glass and razors	1 kg/ week		NA	
	4. Pharmaceutical Waste & Unused and expired drug or medicines	1 kg/ week		2 L/ week	
	5. Vaccines and biological	NA		0.2 L/ week	
	6. Genotoxic Waste: Cytotoxic drugs and other hazardous toxic waste, that's carcinogenic,	0.05 kg / week		0.05 L / week	

Lab departments	Type of solid waste generated	Estimated quantity of waste generated (kg)	Type of liquid waste generated	Estimated volume of liquid waste generated (litre)	Remarks
	mutagenic or teratogenic				
	7. Chemical Waste	0.2 kg/ week	Chemical Waste & disinfectants	0.5 L/ week	
Physicochemical lab: for medicines, biological (including vaccines), food and medical devices (some of the tests are identification, potency/assay, pH, etc.)	Chemical Waste				
	a) Acids, organic and inorganic	NA		1 L/Week	
	b) Bases, organic and inorganic	NA		0.5 L/Week	
	c) Halogen-free organic solvents and solutions	NA		25 L/Week	
	d) Halogenated organic solvents and organic solutions containing halogens	NA		0.5 L/Week	
	e) Saline solutions with a pH between 6 and 8, both organic and inorganic	NA		1L/Week	
	f) Solid organic and inorganic waste chemicals	0.1kg/week		NA	
Toxicological lab: for medicines, biological (including vaccines) and food (some of the tests may require laboratory animals ... handling of lab animals should be taken into consideration.)	1. General/Other Waste: All other, non-hazardous waste				
	a) Animal carcasses, limbs and tissue that are not infectious or contaminated	5 kg/week		NA	
	b) Used animal litter and foodstuffs that are not infectious or contaminated	7 kg/week		NA	
	c) Faeces that are not Infectious or contaminated	5 kg/week		NA	

Lab departments	Type of solid waste generated	Estimated quantity of waste generated (kg)	Type of liquid waste generated	Estimated volume of liquid waste generated (litre)	Remarks
	2. Infectious Waste: Anything that's infectious or contaminated				
	a) Infectious or contaminated animal carcasses and cage linings	1 kg/week		NA	
	b) Infectious or contaminated faeces	1 kg/week		NA	
	3. Pharmaceutical Waste & Unused and expired drug or medicines	1 kg/week		NA	
	4. Sharps & Waste like needles, scalpels, broken glass and razors	0.2 kg/ week		NA	
	5. Vaccines	NA		0.1 L/ week	
Drug evaluation and research laboratory: mostly for medicines, vaccines	The west from this lab can be similar to Physicochemical lab.				

5.7.1. Non-hazardous Waste Management

Assessment of solid waste management facility in Addis Ababa revealed that there is only one functional landfill called Repi landfill. It has a total area is 19.2 hectares and is believed to have a capacity of 3600 tons per day. It receives only mainly household waste and non-hazardous wastes, office, and commercial wastes. Therefore, there is no available space for hazardous waste disposal in Addis Ababa. Non-hazardous wastes generated fromvaccine labwill be disposed in Rapi landfillafter segregation of wastes at source and storage of wastes temporarily within the vaccine laboratory compound.

5.7.2. Hazardous Waste Management

Hazardous wastes must be deposited in so-called secure landfills. However, there is lack of hazardous waste disposal facility in Addis Ababa. Since there is no available space for hazardous waste disposal, hazardous, infectious, and contaminated wastes should be segregated at source and temporarily stored until incinerated.

EFDA will send sterilized wastes produced by the laboratory to incinerator(s) to be installed onsite (within vaccine laboratory compound) for waste disposal. The incinerator(s) to be installed at the campus need to fulfill the emission standard on WBG EHS guidelines (2007).The incinerator will be a pyrolysis incinerator with a capacityto 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 upto <0.1 ng TEQ/m3.

The laboratory will use waste bags for waste collection. Sharp items are collected in safety boxes andspecial hard plastic bottles that designed for sharp materials and will code (red oryellow bags for infectious waste) of laboratory according to its type and use labeling system for thecontainers. After decontamination of wastes generated from the lab,wasteswill be collectedand carried to the incinerators by personnel dedicated for waste handling using cart. The personnel use appropriate PPE during collection and transportation according to safety manual and waste management procedures. Infectious and hazardous wastes from laboratory will be burned in Pyro-lytic Technology incinerators that are designed for laboratory and pharmaceutical hazardouswaste management and fulfill the emission standard (Table 6).

Table 6: Air Emission Levels for Health Facility Waste Incineration Facilities

Pollutants	Units	Guidancevalue
TotalParticulateMatter(PM)	mg/Nm^3	10
Totalorganiccarbon (TOC)	mg/Nm^3	10
Hydrogenchloride (HCl)	mg/Nm^3	10
Hydrogenfluoride (HF)	mg/Nm^3	1
Sulfurdioxide(SO2)	mg/Nm^3	50
Carbonmonoxide(CO)	mg/Nm^3	50
NOx	mg/Nm^3	200-400(a)
Mercury(Hg)	mg/Nm^3	0.05
Cadmium+Thallium(Cd+Tl)	mg/Nm^3	0.05
Sb,As,Pb,Cr,Co,Cu,Mn,Ni and V	mg/Nm^3	0.5
Polychlorinateddibenzodioxinand dibenzofuran(PCDD/F)	Ng/Nm^3TEQ	0.1
Notes: a. 200 mg/m^3 for newplantsorforexistingincineratorswitha normal capacity exceeding6tonesper hour, 400 mg/m^3 for existing incinerators with a nominal capacity of 6 tones per hour or less b. Oxygenlevelforincineratorsis7percent		

Disposal of hazardous ash: Fly ash and bottom ash from incineration is generally considered to be hazardous, because of the waste would have heavy metal content and dioxins and furans may cause potential impacts on water, soil, and biological environment.

Fly ash and bottom ash from incineration require secured landfill for storage. The solid waste disposal facilities must be constructed in low topography areas with fine slopes using burial pit to prevent ground water contamination. The appropriate site will be selected, based on basic factors i.e wind direction; accessibility; environmental issues. Ideally, the pit should be lined with low permeability material such as clay and plastic or concrete based materials at the bottom to prevent the pollution of shallow groundwater and should be fenced in so as to prevent scavenger access. Furthermore, the future stored fly ash management strategy would be under consideration.

5.7.3. Wastewater Treatment

There are multi-layered risks involved in the whole cycle of liquid waste management, especially during collection, transportation, and disposal of laboratory liquid wastes.Liquid contaminated wastes such hazardous chemicals, pathologic and infectious require special

handling, as it may pose an infectious risk to healthcare workers with contact or handle the waste. Therefore, to reduce exposure to such harmful chemicals, it is necessary to design wastewater storage and treatment plants that will treat liquid waste sustainably before disposal.The effluent from the plant must meet the national effluent discharge quality standards, including the Quality Standards for Classified as health facility by WBG before discharge to the environment.

The treatment plant of vaccine lab will have three stages for efficient off-site treatment and discharge to the environment (Figure8).

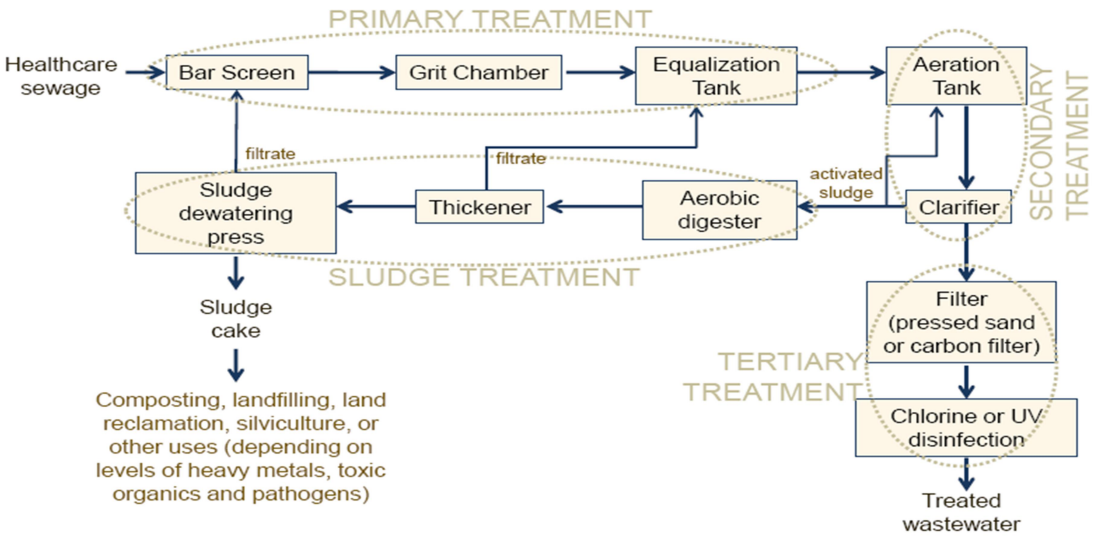

Figure 8*: Flow diagram of proposed EPHI wastewater treatment plant (GEF, Module 23)*

The primary treatment involves the screening of the wastewater to remove solid particles. The screened solid particles will be then incinerated at 850^{o}C to 1200^{0}C in waste incinerated tank. The objective of the primary treatment is to remove of heavy solids. After the screening process, the wastewater will be pumped to biological process tank in which intermittent Aeriation and coagulant (Aluminum) will be provided for simultaneous removal of nitrogen and phosphorus. The wastewater was then pumped to membrane bioreactor which consists of a ceramic membrane having a pore size 0.2µm. The sludge retention time of the biological process will be approximately 30 days. The permeate collected after membrane filtration will be pumped for Ozonation in which 3.4 mg O_3/L of wastewater will be provided for maximum removal of pharmaceuticals. Following the Ozonation process, the treated wastewater will be passed through carbon filter or sand filter. After theSand or carbon filter treatment, the water will be polished using UV radiation for removal of viruses. The UV installation consists of

one UV lamp of 220 W. The wastewater was then discharge to public sewer after fulfilling the limit values for discharges to water (Table 7). The sludge generated during biological process will be dewatered, dried, and then passed to incineration tank. Note that the sludge will be handled and managed ensuring compliance with applicable local and international regulations.

Wastewater Sewerage Network of the Vaccine Lab Complex

The wastewater will be collected from the building complex of the Vaccine Laboratory Complex and is designed to flow by gravity towards the proposed site of the Wastewater Treatment Plant (WWTP) which are located at the lowest part of the Lab since the topographical condition of the site is suitable for gravity-based flow system and this also has the advantage of eliminating costs to be incurred for power while transporting wastewater. The effluent from the WWTP can be used for gardening and floor mopping.

Volume Estimation for Wastewater that needs special Treatment

Volume Estimate

Volume of wastewater that needs special treatment is estimated as follow. The vaccine laboratory accommodates 86 laboratory sinks by which special wastewater generation is expected. Hence, the wastewater flow to the plant is estimated as follows.

Basic Data

→ Total Number of Lab sinks = 86

Total Fixture Discharge

→ Lab Sink = 86 x 3 = 258

Total Fixture unit = 258 Fixture units

From fixture unit discharge table

Discharge for 258 fixture units, flow = 75.16 GPM

Converting GPM to L/S =75.16 X 0.0630902 = 4.74 L/S

Daily Water Consumption

In order to design the wastewater special treatment plant, the wastewater gyration has been fixed based on the Ethiopian Building Code Standard for Plumbing Services of Buildings, ES 3960. Wastewater volume is estimated based on the fixture discharge method.

→ Total Fixture unit = 258 Fixture units

From fixture unit discharge table

Discharge for 258 fixture units, flow = 75.16 GPM

Converting GPM to L/S =75.16 X 0.0630902= 4.7 L/S

Daily Wastewater generation

Assumptions:

→ Hourse (hrs) of daily usage of lab sink is considered.

→ 50% average probable water demand factor is considered

Factored flow:

→ 4.7 l/s x 0.5 = 2.37 litre/second

Daily flow:

→ 2.35 l/s x 3600 x 3hrs = 25380 litre/day, Take 25,000 litre/day.

Hence, the volume of daily wastewater generation that need special treatment is $25m^3$.

Volume Estimation for Wastewater that needs special Treatment

Effluent Criteria

For the proposal of the effluent criteria for this project, the following conditions are considered:

→ There is a plan to make the premises of the lab to beautify with gardens and to realize this; the effluent of the treatment plant would be used as input. According to the relevant WHO guidelines treated wastewater should not contain no more than one helminthes egg per litre and no more than 1000 faecal coli forms per 100 ml if is to be used for irrigation (Gardening),

→ If the effluent volume is greater than the garden and floor mopping water requirement especially in the rainy season, the treated wastewater can be discharged into flood draining ditch. Therefore, these should not be polluted.

→ High content of nitrate in drinking water can cause urgent health risks for small children.

→ Phosphorus as limiting value is not adequate in the project areas.

→ Considering these binding conditions, the following effluent quality standards are assigned.

Table 7: Effluent Levels for Health Care Facilities (WBG, 2007)

Effluent LevelsforHealthCareFacilities

Pollutants	Units	Guidelinevalues
pH	S. U	6 – 9
BiochemicalOxygenDemand(BOD5)	mg/L	50
Chemical Oxygen Demand(COD)	mg/L	250
Oiland grease	mg/L	10
TotalSuspendedSolid(TSS)	mg/L	50
Cadmium(Cd)	mg/L	0.05
Chromium (Cr)	mg/L	0.5
Lead(Pb)	mg/L	0.1
Mercury(Hg)	mg/L	0.01
Chlorine,totalresidue	mg/L	0.2
Phenol	mg/L	0.5
TotalColiformbacteria	MPN[a]/100 ml	400
Polychlorinateddibenzodioxin anddibenzofuran (PCDD/F)	Ng/L	0.1
Temperatureincrease	^{o}C	<3[b]

Notes:

[a]MPN=MostProbable Number

[b]At the edge of a scientifically established mixing zone which takes into accountambientwaterquality,receivingwateruse,potentialreceptorsand assimilative capacity

6. POTENTIAL ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT

In this chapter, identification, prediction, and analyses of potential positive and negative impacts of construction and operation of the proposed vaccine lab building is presented. Impact analysis involves determination of magnitude, extent, duration, and significance of potential impacts. A detailed assessment of impacts is presented in ESIA document. Potential impacts and mitigation measures related to the construction and operation activities are discussed below.

6.1.Pre-construction Phase

Impact due to Faulty Planning Phase (Preconstruction Phase)

During design phase, the layout of the proposed laboratory may not meet the standard of the laboratory facility infrastructure requirements and due to this the laboratory personnel may be exposed to infectious diseases and occupational health hazards. To minimize these types of health impacts the laboratory layout would ensure enough space for the personnel to have safe working environment, and waste disposal system. The EHS Guidelines for facility design and WHO Laboratory Biosafety manual third edition include information relevant to management environment, health and safety issues associated with laboratories. These guidelines are applicable for planning new laboratory facilities to minimize impacts as follow:

WBG EHS Guidelines for Facility Design

The EHS Guidelines for facility design include information relevant to management of EHS issues associated with laboratories which includes a diverse range of activities involving a referral hospital; inpatient and outpatient facilities. These guidelines are applicable for planning new laboratory facilities. These guidelines advise that design and functional layout of laboratory would ensure the following:

- → Separation of clean /sterilized and dirty/ contaminated materials and people flow.
- → Development and inclusion of adequate disinfection/sterilization procedures and facilities.
- → Adequate space for the storage of recyclable materials (cardboard and plastic) for pickup.
- → Ventilation systems that provide isolation and protection from airborne infections.

→ Design of water systems to provide adequate supplies of potable water to reduce risks of exposure waterborne pathogens.

→ Provision of hazardous material and waste storage and handling areas.

→ Selection of easily cleaned building materials that do not support microbiological growth, are slip-resistant, non-toxic, and non-allergenic, and do not include volatile organic compound (VOC)-emitting paints and sealants.

6.2.Construction Phase

6.2.1. Construction Phase Positive Impacts

i) Stimulation of local economy

The construction phase civil works require materials such as gravel, bricks, lumber and cement. These inputs will come from the local suppliers; hence the benefit would go to the local community. In addition, the vaccine laboratory will also require supplies from abroad. So, the impact has local and regional spatial extent. It is a positive but short-term impact.

Enhancement measure: The contractual agreement with the vaccine lab construction contractor needs to incorporate the use of locally produced construction material supplies under every possible condition. This will increase the quantity of materials to be procured from the local suppliers.

ii) Labour influx, employment, and gender

The contractual agreement needs to encourage use of local labor/skill in the construction process. This will enhance job opportunity and positive look to the project. The contractor also needs to observe those privileges and affirmative actions specified in labor proclamation (Proclamation No 1156/2019) article 87 and 88 for women. The proposed project will create skilled, unskilled and semi-skilled temporary jobs during construction phases and permanent jobs during operation. This would be a positive impact lasting through the construction and operation phases, respectively. Owing to the moderate size of the proposed vaccine Laboratory project building, it is anticipated that this project will not become a mega attraction causing labor influx into the city. When it comes to employment, giving priorityto women workers will contribute to reducing the dependency of women on men andencourages women to learn new skills.

Enhancement measure: Wherever feasible, local people from the city(particularly Akaki kality sub-city) need be considered for job opportunities commensurate with their level of skills. Ensure that at least 60% of the casual employment is drawn from the local communities.

iii) Other Positive Impacts

The proposed project has an overall positive implication to the country. The benefits include:

It will support local food & pharmaceuticals manufacturing industries and enable the country and regulatory authorities in the region to cope with the dramatic changes in pharmaceutical technologies and control of SSFFCs and modernize the regulatory practices in the region.

Transporters: Investors on lorry and trailer transport will benefit greatly from the project. This benefit will extend to vehicle dealers, manufacturers and lorry drivers.

Sand Harvesters: Locals involved in sand harvesting in nearby areas are to be major beneficiaries of the project. The benefits will extend to the regional government entitled to levy taxes on sand transporters.

Ballast Quarries: There will be massive use of ballast. This will ensure that the quarry owners and workers benefit greatly.

Cement Manufacturers: The local cement manufacturers, their employees and shareholders are direct beneficiaries of the development. The government will also get additional revenue in V.A.T. and other taxes levied on cement.

Manufacturers and dealers of other building materials: Most of the building materials to be used can be locally manufactured. Therefore, relevant companies, their workers and shareholders will be direct beneficiaries of the development.

6.2.2 Construction Phase Environmental Impact and Risk

According to WBG EHS Guidelines for Construction and Decommissioning the impacts are categorized by thematic groups, in to three major aspects: namely environment, OHS and community health and safety. During construction of the proposed laboratory, impact may occur to environment, workers, and community.

Environmental impact includes noise and vibration, air pollution, solid waste and liquid waste generation. Occupational safety of workers can be impacted while workers engage in the

project activity such as over-exertion, slips and falls, work at heights, hot works (welding) and electrocution, being struck by objects, injury by moving machinery and dust from construction activities. Community health impacts are related to injuries from construction activities, disease transmission and traffic accident for people in or near buildings under construction.

6.2.2.1.Soil Erosion

Excavation works related to construction of the vaccine laboratory building will expose soils in the affected areas leaving them vulnerable to erosion by surface run-off, a negative consequence. The flat topography of the site would tend to reduce erosive surface flows and the threat will exist only for the duration of construction works before landscaping and drainage works are put in place that would reduce the susceptibility to soil erosion.

The intensity of the impact will be very low given that the soil is clay and the duration is short. The sensitivity of the receptors is low because it is a flat land. Hence significance of the impact is minor.

Impact Significance

		Sensitivity of receptor			
		Very low 1	Low 2	Medium 3	High 4
Intensity of impact	Very low 1	1 Negligible	2 Minor	3 Minor	4 Minor
	Low 2	2 Minor	4 Minor	6 Moderate	8 Moderate
	Medium 3	3 Minor	6 Moderate	9 Moderate	12 Major
	High 4	4 Minor	8 Moderate	12 Major	16 Major

Mitigation for soil erosion

- Soil erosion prevention measures would be in place during the construction phase to minimize erosion.
- Re-cover exposed soils with grass and other appropriate species as soon as possible.
- Temporarily bund exposed soil and redirect flows from heavy runoff areas that threaten to erode or result in substantial surface runoff.

- Monitor areas of exposed soil during periods of heavy rainfall throughout the construction phase of the project.

6.2.2.2.Air Pollution

During site preparation and construction of the proposed Vaccine lab project, the use of heavy equipment would generate combustive- engine exhausts that would contribute to air pollution. However, since there would be very few of these pieces of equipment and their use would be limited in time, the potential effect on ambient air quality would be temporary and localized. During construction activities, there would be a temporary increase in particulate emissions. The operation of construction vehicles such as dump trucks, cranes, and those involved to transport building materials and waste would generate emissions of SO_2, CO_2, CO, NO_x and particulate matter. However, the potential effect of these emissions on ambient air quality would be localized and have an impact for a short duration only during clearance preparation and construction activities.

Though the laboratory is in the middle of the town, the traffic density is low. The number of machineries to be deployed for a modest vaccine lab building is few; so the impact intensity is low. On the other hand, the sensitivity on the receptors side is medium resulting in moderate impact significance.

Impact Significance

		Sensitivity of receptor			
		Very low	Low	Medium	High
		1	2	3	4
Intensity of impact	Very low 1	1 Negligible	2 Minor	3 Minor	4 Minor
	Low 2	2 Minor	4 Minor	6 Moderate	8 Moderate
	Medium 3	3 Minor	6 Moderate	9 Moderate	12 Major
	High 4	4 Minor	8 Moderate	12 Major	16 Major

Mitigation measures for impact on air quality

- Safety officer at the facility should have authority to inspect and restrain contractors from generating excessive dust within healthcare buildings.

- Trucks shall be covered during haulage of construction materials and should be diverted away from busy areas of the hospital
- Restrict burning of solid wastes onsite
- Construction work should be undertaken by an experienced and duly registered contractor with a verifiable sense of environmental awareness and responsibility.
- 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.
- Workers will be provided with PPE and the use of PPE shall be enforced.
- Regardless of the size or type of vehicle, fleet operators should implement the manufacturer recommended engine maintenance programs;
- Trucks would be covered during haulage of construction materials and will be diverted away from busy areas of the site.
- Drivers should be instructed on the benefits of driving practices that reduce both the risk of accidents and fuel consumption, including measured acceleration and driving within safe speed limits;
- Operators with fleets of 120 or more units of heavy duty vehicles (buses and trucks), or 540 or more light duty vehicles (cars and light trucks) within an air shed should consider additional ways to reduce potential impacts including:
    - Replacing older vehicles with newer, more fuel efficient alternatives
    - Converting high-use vehicles to cleaner fuels, where feasible
    - Installing and maintaining emissions control devices, such as catalytic converters
    - Implementing a regular vehicle maintenance and repair program

6.2.2.3.Nuisance Dusting

It can be anticipated that a certain amount of air borne particulate matter (dust) will be generated by earth moving activities during excavation and building construction and during off-loading. It may entail human health impact, may intensify respiratory health problems, impair visibility, cause nuisance to neighbors and/or workers. This situation will be worst during the dry season. Because the site is in the middle of the town, air borne particulates could pose hazard to residents in the vicinity or downwind of the construction site. Because the construction is with in the hospital compound, there would be higher sensitivity and

reaction to dust nuisance. On the other hand, the occurrence of dusting is periodic and short-term, lasting for the duration of the construction activity and in the dry season only.

Impact Significance

		Sensitivity of receptor			
		Very low 1	Low 2	Medium 3	High 4
Intensity of impact	Very low 1	1 Negligible	2 Minor	3 Minor	4 Minor
	Low 2	2 Minor	4 Minor	6 Moderate	8 Moderate
	Medium 3	3 Minor	6 Moderate	9 Moderate	12 Major
	High 4	4 Minor	8 Moderate	12 Major	16 Major

Mitigation for dust

- Access roads and exposed ground should be regularly wetted in a manner that effectively keeps down the dust.
- Stockpiles of fine materials should be wetted or covered with tarpaulin or anything similar during windy conditions.
- Workers on the site should be issued with dust masks during dry and windy conditions.
- Direction of wind need to be considered at time of site selection for the vaccine Laboratory
- Trucks carrying dusty material to be covered with canvas sheet.
- Limit haul truck traffic only to authorized routes and designated entrance and exit points.
- Promote the progressive re-vegetation

6.2.2.4.Impacts of Noise and Vibration

Pre-construction phase will involve site clearance activity for development of access road and the project. Clearance of site will involve removal of vegetation and land leveling activities by using machineries which lead to generation of noise.

It is possible that noise levels would exceed at least for periods of several minutes at a time of working 8-hour 75-dBA threshold limit value, but only during daylight hours and only in the immediate vicinity of the site preparation and construction activity. Members of the public would not be exposed during the daytime or night-time to noise levels exceeding city planning (ambient noise level greater than 75 dBA beyond the boundaries of the site, nor greater than 60 dBA at the boundary of a residential district). This is predicated on the distance of the proposed facility being about 400 m to the nearest residence.

Heavy equipment such as front-end loaders and backhoes would produce intermittent noise levels at around 73 to 94dBA at 15m from the work site under normal working conditions (Cantor, 1996). Construction truck traffic would occur frequently but would generally produce noise levels below that of the heavy equipment. The finishing work within the building structures would create noise levels slightly above normal background levels for the nearby areas. Noise levels may go up to around 80dBA at the work site if light machinery is used in this stage of construction (Cantor, 1996). Workers would be required to have hearing protection if site-specific work produced noise levels above the compound action level of 80dBA for steady-state noise.

During construction activities, noise and vibration may be caused by the operation of pile drivers, earth moving and excavation equipment, concrete mixers, cranes and the transportation of equipment, materials, and people. Considerable levels of noise and vibrations will mainly result from use of heavy construction equipment. Relatively high noise levels are also expected in the area during demolition phase.

In this document the Ethiopia guideline standard for noise and World Bank guidelines have been adopted and are used for benchmarking purposes along with the draft National Noise Standards that are being prepared. The guidelines being adopted by EPA for Ethiopia for daytime perimeter noise is 55 decibels (DBA) in residential area. Table 8 provides the provisional noise standards being adopted by WB guidelines values.

Table 8: Limit Values for Noise level (Source: EPA, 2003)

Area Code	Category of Area	Limits in DBA	
		Day time[1]	**Night time[2]**
A	Industrial area	75	70
B	Commercial area	65	55
C	Residential area	55	45

Note

Day time reckoned to be between 6.00 am to 9.00pm

Night time reckoned to be between 9.00pm to 6.00am

Construction noise and vibration from manual or motorized demolition activities could affect construction workers. Though the level of discomfort caused by noise is subjective, the most commonly reported impacts of increased noise levels are interference in oral communication (Stansfeld and Matheson, 2003) and disturbance to some vibration sensitive near project implementing surrounding. Impact receptors include construction workers, near community and their attendants. The impact ***intensity***will be ***medium and short term*** if an experienced contractor is contracted to carry out the constructionactivities. However, ***sensitivity*** on receptors will be ***medium***, hence a ***moderate*** impact significance.

Impact significance

		Sensitivity of receptor			
		Very low 1	Low 2	Medium 3	High 4
Intensity of impact	Very low 1	1 Negligible	2 Minor	3 Minor	4 Minor
	Low 2	2 Minor	4 Minor	6 Moderate	8 Moderate
	Medium 3	3 Minor	6 Moderate	9 Moderate	12 Major
	High 4	4 Minor	8 Moderate	12 Major	16 Major

Mitigation measures for noise impact

The following action will be the mitigation strategies:

- Construction activities that will generate disturbing sounds should be restricted to normal working hours.
- 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.
- Contractor will ensure that equipment is properly serviced and efficient.
- Contractors will cordon off construction equipment units with noise absorbing materials, for example, plywood rather than iron sheets.

- Construction workers will be aware of the sensitive nature of workplaces they are operating in and advised to limit verbal noise or other forms of noise. For example, metallic objects or tools can be passed on to a colleague rather than dropping or throwing them with loud bangs.
- The contractor will 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.
- Noise and vibration will be minimized at the project site and surrounding areas through sensitization of construction truck drivers to switch off vehicle engines while offloading materials.
- All generators and heavy-duty equipment will be insulated or placed in enclosures to minimize disrupting ambient noise levels.
- Local residents should be given notice of intended noisy activities so as to reduce the degree of annoyances
- Workers operating equipment that generates noise should be equipped with noise protection.
- Regular servicing and maintenance of construction equipment. Install silencers to curb excessive noise if need be
- Establish an inspection program for equipment. Avoid leaving vehicles and other equipment idling for prolonged periods (switch of motor when idle).

Moreover, the project will adhere to the application of salient practices from the WBG EHS Guidelines for Construction and Decommissioning. These provide specific guidance on prevention and control of noise and vibrations recommended noise and vibration reduction and control strategies includes:

- Planning activities in consultation with local communities so that activities with the greatest potential to generate noise are planned during periods of the day that will result in least disturbance. Construction activities during night time should be avoided.
- Using noise control devices, such as temporary noise barriers and exhaust muffling devices for combustion engines. Noise due to construction machineries should be minimized by introducing silencer to the construction machineries
- Avoiding or minimizing project transportation through community areas

6.2.2.5.Earth Material Sourcing

Earth materials needed for construction will be obtained from quarry and mining operations. Unwitting purchase of these materials from unlicensed operations indirectly supports, encourages and promotes environmental degradation at the illegal quarry sites and causes medium to long-term negative impacts at source.

Impact Significance

		Sensitivity of receptor			
		Very low 1	Low 2	Medium 3	High 4
Intensity of impact	Very low 1	1 Negligible	2 Minor	3 Minor	4 Minor
	Low 2	2 Minor	4 Minor	6 Moderate	8 Moderate
	Medium 3	3 Minor	6 Moderate	9 Moderate	12 Major
	High 4	4 Minor	8 Moderate	12 Major	16 Major

Mitigation for impacts associated with earth material sourcing

- Earth materials must be obtained from officially licensed and approved quarries and copies of the relevant licenses made available by the Contractor for inspection at the site.
- Site restoration and rehabilitation activities will be undertaken by the contractor.

6.2.2.6.Materials Transportation Impacts

The various materials required for construction and building (e.g. steel, blocks, lumber, cement, etc.) will be obtained from sources elsewhere and transported to the site. Transportation of these materials, typically in over-laden and uncovered trucks, usually results in undue road wear-and-tear.

In the case of fine earth materials, dusting and spillages occur on the roadways between source and site. Dusting degrades local air quality and material spillages worsen driving conditions and increase the risk of road accidents. These occurrences represent indirect, short-term, reversible, negative impacts on public health and safety.

Impact significance

Intensity of impact	Sensitivity of receptor			
	Very low1	Low2	Medium 3	High 4
Very low 1	1 Negligible	2 Minor	3 Minor	4 Minor
Low 2	2 Minor	4 Minor	6 Moderate	8 Moderate
Medium 3	3 Minor	6 Moderate	9 Moderate	12 Major
High 4	4 Minor	8 Moderate	12 Major	16 Major

Mitigation for transport related inconvenience

- All fine earth materials must be enclosed during transportation to the site to prevent spillage and dusting. Trucks used for that purpose should be fitted with tailgates that close properly and with tarpaulins to cover the materials. The cleanup of spilled earth and construction material on the main roads should be the responsibility of the Contractor and should be done in a timely manner so as not to inconvenience or endanger other road users. These requirements should be included as clauses within the contracts agreement.
- The transportation of lubricants and fuel to the construction site should only be done in the appropriate vehicles and containers, i.e. fuel tankers and sealed drums.
- As far as possible, transport of construction materials should be scheduled for off-peak traffic hours. This will reduce the risk of traffic congestion and of road accidents on the access roads to the site.
- Appropriate traffic warning signs, informing road users of a construction site entrance ahead and instructing them to reduce speed, should be placed along the main road in the vicinity of the entrance to the site.
- Flagmen should be employed to control traffic and assist construction vehicles as they attempt to enter and exit the project site.

6.2.2.7.Impacts Associated with Materials Storage

The improper sitting of stockpiles and storage of sand, gravel, cement, etc., at the construction sites could lead to fine materials being washed away, during heavy rainfall events, into the drainage system.

Improper storage, handling and spillage of hazardous and flammable materials (paints, thinner, solvents, etc.) on the site could have the potential to contaminate soil and inhibit plant growth in localized areas. It is anticipated that re-fueling or maintenance of large vehicles will take place on the construction site and therefore there will be a requirement to store fuel and lubricants in a safe manner on the site.

Impact significance

		Sensitivity of receptor			
		Very low 1	Low 2	Medium 3	High 4
Intensity of impact	Very low 1	1 Negligible	2 Minor	3 Minor	4 Minor
	Low 2	2 Minor	4 Minor	6 Moderate	8 Moderate
	Medium 3	3 Minor	6 Moderate	9 Moderate	12 Major
	High 4	4 Minor	8 Moderate	12 Major	16 Major

Mitigation for problems arising from storage

- The stockpiling of construction materials should be properly controlled and managed. Fine grained materials (sand, marl, etc.) should be stockpiled away from surface drainage channels and features.
- Safe storage areas should be identified and retaining structures put in place prior to the arrival and placement of material.
- Hazardous chemicals (e.g. fuels) should be properly stored in appropriate containers and these should be safely locked away. Conspicuous warning signs (e.g. 'No Smoking') should also be posted around hazardous waste storage and handling facilities.

6.2.2.8.Modification of Surface Drainage Impacts

The impervious surface created by the covered building area and the surface areas of cemented/asphalted roads will generate some volumes of runoff during the periods of prolonged rainfall. Given the size of the vaccine lab building this impact would be minor.

Impact significance

		Sensitivity of receptor			
		Very low	Low	Medium	High
		1	2	3	4
Intensity of impact	Very low 1	1 Negligible	2 Minor	3 Minor	4 Minor
	Low 2	2 Minor	4 Minor	6 Moderate	8 Moderate
	Medium 3	3 Minor	6 Moderate	9 Moderate	12 Major
	High 4	4 Minor	8 Moderate	12 Major	16 Major

Mitigation for modification of surface drainage

The appropriate design and construction of a storm water drainage system

6.2.2.9.Solid Waste Disposal Impact

Solid waste generated during site preparation and construction work would include cut vegetation and typical construction waste (wasted concrete, steel, wooden scaffolding, bags, waste earth materials, etc.). Solid waste will also be generated from office and Kitchen during construction project activities. These wastes would negatively impact the site and surrounding environment if not properly managed and disposed of at an approved dumpsite. Vegetation and solid waste, if allowed to accumulate in drainage ways, could cause localized pooling and flooding. Pooling of water, in turn, would create conditions conducive to the breeding of nuisance and health-threatening pests such as mosquitoes. Hazardous solid waste includes contaminated soils, which could potentially be encountered on-site due to previous land use activities, or small amounts of machinery maintenance materials, such as oily rags, used oil filters, and used oil, as well as spill cleanup materials from oil and fuel spills has a potential to be generated in construction phase of the project. Poor construction waste management constitutes a short-term, possibly long-term, negative impact.

Impacts Significance

		Sensitivity of receptor			
		Very low	Low	Medium	High
		1	2	3	4
sit y of im	Very low 1	1	2	3	4

	Negligible	Minor	Minor	Minor
Low 2	2	4	6	8
	Minor	Minor	Moderate	Moderate
Medium 3	3	6	9	12
	Minor	Moderate	Moderate	Major
High 4	4	8	12	16
	Minor	Moderate	Major	Major

Mitigation for problems associated with construction waste disposal

- A site waste management plan should be prepared by the contractor prior to commencement of building. This should include the designation of appropriate waste storage areas, collection and removal schedule, identification of approved disposal site, and a system for supervision and monitoring. Preparation and implementation of the plan must be made the responsibility of the building contractor with the system being monitored independently.
- Special attention should be given to minimizing and reducing the quantities of solid waste produced during site preparation and construction.
- Vegetation and combustible waste must not be burned on the site.
- Reusable inorganic waste (e.g. excavated sand) should be stockpiled away from drainage features and used for in filling where necessary.
- The contractor will segregate and separate the wastes properly to encourage recycling of some useful waste materials.
- Hazardous wastes will not be mixed with other solid waste generated and will be managed by way of incineration or land-filling.
- Waste will be collected from the site at least once in 24 hours and when temporarily kept on site it will be covered to minimize nuisance odour and vermin.
- Unusable construction waste, such as damaged pipes, formwork, and other construction material, must be disposed of at an approved dumpsite.

In addition, the proposed project will adhere to the application of salient practices from the WBG EHS Guidelines for Construction and Decommissioning. These provide specific guidance on prevention and control of community health and safety impacts that may occur during new project development or due to expansion or modification of existing facilities.

6.2.2.10. Impacts Associated with Sewage and Litter Management

If toilets are not provided to workers, there would be ad hoc defecation in secluded areas on the site. This will create unsanitary conditions and could be sources of fly infestation. Improper disposal of food cartons and other domestic forms of construction camp garbage could lead to littering of the site. This is a short-term impact but the impact receiving environment is sensitive.

Impact Significance

		Sensitivity of receptor			
		Very low	Low	Medium	High
		1	2	3	4
Intensity of impact	Very low 1	1 Negligible	2 Minor	3 Minor	4 Minor
	Low 2	2 Minor	4 Minor	6 Moderate	8 Moderate
	Medium 3	3 Minor	6 Moderate	9 Moderate	12 Major
	High 4	4 Minor	8 Moderate	12 Major	16 Major

Mitigation for nuisance from Sewage treatment and disposal

- There has to be adequate toilet facility for construction workers or arrangement with the hospital management to use the hospital's facility Construction workers need to be instructed on how to manage wastes

6.2.2.11. Impacts on Ecological Resources and Biodiversity

The Vaccine Laboratory building will be constructed in a secured compound and hence will have reduced impact on threatened or endangered species habitat. Only small portion of vegetation would be removed for clearing the construction site.

Extent of this impact could have temporary effects to vegetation in the immediate area. However, these minor effects would not be long term. The intensity of the impact will be very low because the size of the construction is not big. The sensitivity of the receptors is rated low. Hence significance of the impact is Minor.

Impact Significance

		Sensitivity of receptor			
		Very low	Low	Medium	High
		1	2	3	4
Intensity of impact	Very low 1	1 Negligible	2 Minor	3 Minor	4 Minor
	Low 2	2 Minor	4 Minor	6 Moderate	8 Moderate
	Medium 3	3 Minor	6 Moderate	9 Moderate	12 Major
	High 4	4 Minor	8 Moderate	12 Major	16 Major

Mitigation strategies for impact on ecological resources and biodiversity

- Limit extent of vegetation and tree clearing
- Replant and re-vegetate promptly

6.2.2.12. Occupational Health and Safety (OHS) Impacts

During this phase, several OHS risks may occur due to exposure to occupational hazards such has physical hazards, at the project site. Several OHS risks as a result of the important activities, processes, materials and equipment carried out during the pre-construction and construction phases of the project are listed as given below:

Physical hazards

i) Slip, trip, and falls: Working at heights, Spills, ice, snow, rain, loose mats, rugs, and stepladders are some of the common causes of slips, trips, and falls during construction. Persons falling into excavations, plant and materials falling into excavations,collapse of formwork, falling materials or debris, risk from lifting operations, cuts and abrasions, weakening of adjacent structures (if any), striking existing services/utilities (if any)).

Slip, Trip and fall mitigation Measures

- Conducting audits as required ensuring responsibilities are met.
- Ensuring employees receive appropriate training and instructions.
- Deal with spills straight away as per spill response plan.
- Consider routine monitoring of areas where spills are a high risk.
- Use absorbent material to soak up the spill.
- Identify areas at high spill risk and locate absorbent materials nearby.

- ❖ Where possible avoid using wet cleaning as this may spread the potential danger area
- ❖ Consider using spill kits.
- ❖ Ensure slip resistant footwear is provided and worn as needed Providing personal protective equipment (slip-resistant footwear) if required.

ii) Manual handling: lift heavy objects using inappropriate body posture and driving equipment with improper brake system Muscle skeletal disorder problem might be happened unless properly manage manual handling hazards.

Manual Handling Mitigation Measures

- ✓ Using mechanical assist devices to relieve heavy load lifting and carrying tasks or using handles.
- ✓ Reducing shift length or limiting the amount of overtime.
- ✓ Rotating workers through jobs that are physically tiring.
- ✓ PPE generally provides a barrier between the worker and hazard source.

iii) Eye hazard: bright lights from welding operations, UV radiation given off by electric arc welding, Eye injury due to flying debris, Eye irritation due to Volatile Organic Carbons (VOCs), struck by moving objects/equipment.

Eye Hazard Mitigation Measures

- Always to wear personal protective eyewear for workers working on high dust and eye goggles for welders,
- Clean your eyewear several times throughout the day, and always brush yourself off before removing your safety glasses, It's vital to call for medical attention (get treatment) when you notice the following signs in yourself or coworkers such as blood in the clear part of an eye, cut or torn eyelid, one eye doesn't move as well as the other, one eye sticks, pain or trouble seeing, unusual pupil dilation or shape

iv) Electrical hazards: All equipment needs 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.

Electrical Hazards Mitigation Measures

- Inspect portable cord-and-plug connected equipment, extension cords, power bars, and electrical fittings for damage or wear before each use. Repair or replace damaged equipment immediately,
- Always locate all powerlines on or near the project sites,
- Perform regular fire risk assessments to identify areas at risk of bad wiring and circuits,
- Maintain proper grounding to eliminate unwanted voltage and reduce the risk of electrocution,
- Verify that all wiring is coming from a properly rated circuit and doesn't exceed capacity

v) Ergonomic hazards: poor working design, working at heights, frequent lifting, vibration.

Ergonomic Hazards Mitigation Measures

- Adjust the height of working surfaces to reduce long reaches and awkward postures,
- Put work supplies and equipment within comfortable reach,
- Provide the right tool handle for the worker,
- Vary tasks for workers (employ job rotation),
- Encourage short rest breaks,
- The contractor should be responsible for adequate first-aid services are provided to the employees at all times,

vi) Rotating and moving equipment: Injury or death can occur from being trapped, entangled, or struck by equipment machinery parts such as saws, tractors, grinders, moving heavy materials,hammers, steel pipes and fittings, sharp edges of nails.

Rotating and Moving Equipment Mitigation Measures

- Proper design considerations include two-hand operated machines to prevent amputations or the availability of emergency stops dedicated to the machine and placed in strategic locations.
- Machine or equipment should be equipped with,and protected by, a guard or other device that prevents access to the moving part or pinch point.
- Turning off, disconnecting, isolating, and de-energizing(Locked Out and Tagged Out) machinery with exposed orguarded moving parts, or in which energy can be stored (e.g.compressed air, electrical components) during servicing or maintenance.

- Designing and installing equipment, where feasible, to enable routine service, such as lubrication, without removal of the guarding devices or mechanisms.

vii) Traffic accident impacts

Poorly trained or inexperienced vehicle drivers have increased risk of accident with other vehicles, pedestrians, and equipment. Construction activities may also result in an increase in number of vehicles during transport of construction materials and equipment, which will lead to increased risk of traffic-related accidents or injuries to workers and community. Duration of the impact will be short-term occurring only during the construction phase. The sensitivity of receptors is high given that some accidents would lead to permanent damage and others loss of life while the intensity of the impact is low given the relatively small increase of traffic volume caused by the construction activities. Therefore, significance of the impact is moderate.

Impact Significance

		Sensitivity of receptor			
		Very low 1	Low 2	Medium 3	High 4
Intensity of impact	Very low 1	1 Negligible	2 Minor	3 Minor	4 Minor
	Low 2	2 Minor	4 Minor	6 Moderate	8 Moderate
	Medium 3	3 Minor	6 Moderate	9 Moderate	12 Major
	High 4	4 Minor	8 Moderate	12 Major	16 Major

Mitigation measures for traffic impacts

According to EHSG, site traffic safety practices include:

- Training and licensing vehicle operators in the safe operation of specialized vehicles such as excavators, including safe loading/unloading, load limits.
- Ensuring drivers undergo medical surveillance.
- Ensuring moving equipment with restricted rear visibility is outfitted with audible back-up alarms.

- Establishing rights-of-way, site speed limits, vehicle inspection requirements, operating rules and procedures, and control of traffic patterns or direction.
- Restricting the circulation of delivery and private vehicles to defined routes and areas, giving preference to 'one-way' circulation, where appropriate or provide only permitted gates and access roads which is allowed for construction machineries and trucks.
- Safe traffic control measures should be used, including flag persons to warn of dangerous conditions and Installation of appropriate road signage, speed signs, and other warning signs at the site and access roads,
- Initiation of a safety program and measures by creating awareness and educational campaigns for drivers, workers and local communities, including observation of speed limits,
- Sanctions for reckless driving,
- Copies of drivers 'licenses and insurance policies for the Contractor's drivers and vehicles respectively should be provided to the Supervision Consultant.
- All construction machineries and cars should have third-parties insurance.

Generally, the impact of physical hazard during the construction phase is a short-term occurring only. Extent of the impact is limited on construction sites. Ethiopia Occupational Safety and Health Directive and WB Guidelines entitle workers for provision of PPE and safe working conditions, free of nuisance, which are likely to be harmful and dangerous to health at workplaces. The likelihood of the impact occurring will be high considering the usually low level of safety at construction sites in Ethiopia. Intensity of the impact will be medium given that some accidents could be minor and not life threatening while others can be grave leading to permanent disability or loss of life of construction workers. Sensitivity of the receptor is medium resulting in moderate impact significance.

Impact Significance

		Sensitivity of receptor			
		1 Very low	2 Low	3 Medium	4 High
Intensity of impact	Very low 1	1 Negligible	2 Minor	3 Minor	4 Minor
	Low 2	2	4	6	8

	Minor	Minor	Moderate	Moderate
Medium 3	3	6	9	12
	Minor	Moderate	Moderate	Major
High 4	4	8	12	16
	Minor	Moderate	Major	Major

General Physical Hazards Mitigation Measures

- Scan the workplace for existing and potential hazards before work begins and take appropriate controls. Be aware that conditions can change constantly,
- Use correct personal protective equipment and apparel, including safety footwear,
- Have training before beginning any task, especially high-risk activities such as working at heights, hazardous energy control (lockout/tag out), or confined space entry,
- Prepare and emergency response plan and be aware of the emergency response plans before work begins,
- Develop evacuation procedures to handle emergency situations.
- Safety glasses/face shield for those working with any chemical or using any mechanical equipment to protect their eyes and face,
- For hand, use correct gloves for the job for workers at concrete batching plant,
- Placing readable signs alerting people of hazardous such as for slippery floors,
- Insuring against liability for any loss, damage, death or bodily injury which may occur to any physical property or to any person which may arise out of the Contractor's performance of the contract.

Chemical hazards

Concrete and masonry products contain silica sand and rock containing silica from inhalation of dust, inhalation of Volatile Organic Carbons (VOCs). When workers inhale crystalline silica, the lung tissue reacts by developing fibrotic nodules and scarring around the trapped silica particle. This fibrotic condition of the lung is called silicosis. If the nodules grow too large, breathing becomes difficult and death may result. lack of concentration while working and exposure to hazardous wastes such as paints, cement, adhesives, and cleaning solvents, all may cause physical injuries to construction workers.

i) Impact of Chemical Hazard

Construction activities may pose the potential for release of chemicals (petroleum) based products, such as lubricants, hydraulic fluids, or fuels during their storage, transfer, or use in equipment.

Extent of impact is limited to the construction site and hence low. Given the low number of machineries that are going to be employed in the construction activity, the probability that there would be spillage is also low. Sensitivity is also low. If spillage happens, the impact duration will be medium.

Impact Significance

		Sensitivity of receptor			
		Very low	Low	Medium	High
		1	2	3	4
Intensity of impact	Very low 1	1 Negligible	2 Minor	3 Minor	4 Minor
	Low 2	2 Minor	4 Minor	6 Moderate	8 Moderate
	Medium 3	3 Minor	6 Moderate	9 Moderate	12 Major
	High 4	4 Minor	8 Moderate	12 Major	16 Major

Mitigation measures for impacts of Hazardous Materials

Techniques for prevention, minimization, and control of these impacts include:

- Providing adequate secondary containment for fuel storage tanks and for the temporary storage of other fluids such as lubricating oils and hydraulic fluids,
- Using impervious surfaces for refueling areas and other fluid transfer areas
- Training workers on the correct transfer and handling of fuels and chemicals and the response to spills
- Providing portable spill containment and cleanup equipment on site and training in the equipment deployment
- Assessing the contents of chemical substances and petroleum-based products in building systems (PCB containing electrical equipment, asbestos-containing building materials) and process equipment and removing them prior to initiation of project, and

managing their treatment and disposal according to EHSG Sections 1.5 and 1.6 on Hazardous Materials and Hazardous Waste Management, respectively

- Assessing the presence of hazardous chemical substances in or on building materials (polychlorinated biphenyls, asbestos containing flooring or insulation)
- Training workers in the use of the available information (such as MSDSs), safe work practices, and appropriate use of PPE.

ii) Fire and Explosion Hazards

Portable gasoline containers for generators and other gasoline powered equipment have a potential for fire and explosion hazards. Fuel transfers for onsite heavy equipment operation, ignition of flammable materials during hot works, welding operations that create spark, risk of electrocution. Fires and or explosions resulting from ignition of flammable materials or gases can lead to loss of property as well as possible injury or fatalities to project workers and may cause damage to the environment, and property as well. Moreover, most of the construction equipment will be powered by gasoline, hence there could be risk of gasoline containers catching fire.

Duration of the impact would be *short and is incidental*, local in spatial extent affecting onsite facilities, patients, lab workers and neighboring communities with possibly irreversible impact. The likelihood of the impact occurring is yet *low* given that it is standard laboratory design. However, *sensitivity* on the receptors will be *medium*, hence impact *significance* is moderate.

Impact Significance

		Sensitivity of receptor			
		Very low	Low	Medium	High
		1	2	3	4
Intensity of impact	Very low 1	1 Negligible	2 Minor	3 Minor	4 Minor
	Low 2	2 Minor	4 Minor	6 Moderate	8 Moderate
	Medium 3	3 Minor	6 Moderate	9 Moderate	12 Major
	High 4	4 Minor	8 Moderate	12 Major	16 Major

Mitigation Measures for Fire and Explosion Impacts

The contractor needs to make gasoline available on a daily base consumption in order to decrease risk of explosion (avoid gasoline stocking). The contractor should employ lightning protection designed to meet the requirements. All Equipment runs by electric power need to have electrical safety for there is a risk of electric hazard in the site.

Prevention and control strategies include:

- Ensure the provision of fire extinguishers at all work locations and at all times.
- All flammable gases, liquids and vapors are removed before the start of any hot work.
- Where appropriate, use spark-resistant tools, and make sure all equipment is bonded or grounded properly,
- Ensure provisions of first aid for staff, insurance, and access to ambulance service at all worksites, and arrangement (agreement) to access local hospital/dispensary with qualified medical staff by workers,
- The construction site shall be fenced off to prevent access to members of the public,
- Providing adequate storage for hazardous and flammable substances and controlling access to them. It means it is storing away from ignition sources and oxidizing materials
- Monitoring the movement, handling and management of wastes to ensure they safely managed and don't present any EHS risks,
- Establish clinics and equip with appropriate medical equipment for first aid treatment.
- Have natural or passive floor and ceiling level ventilation and explosion venting.
- Defining and labeling fire hazards areas to warn of special rules (prohibition in use of smoking materials, cellular phones, or other potential spark generating equipment)
- Providing specific worker training in handling of flammable materials, and in fire prevention or suppression.

Fire Precautions

The workplace should be designed to prevent the start of fires through the implementation of fire codes applicable as indicated in Ethiopian Building Code Standard. Other essential measures include:

- Equipping facilities with fire detectors, alarm systems, and fire-fighting equipment. The equipment should be maintained in good working order and be readily accessible. It should be adequate for the dimensions and use of the premises, equipment installed.
- Provision of manual firefighting equipment that is easily accessible and simple to use.
- Fire and emergency alarm systems that are both audible and visible.

Biological hazards

The existence of biological hazards like bacteria, viruses or parasites and mosquitoes carrying disease-causing agents are expected.

Biological Hazards Mitigation Measures

- Construction site should be separated from the main campus by fence and construction workers should be restricted within the site.
- Wasps are attracted by discarded food, so make sure all leftovers go in the garbage, and keep it covered. Remove and reduce debris and rubble piles when possible, to help keep insects and rodents away.
- Vaccine, and other biological products should be properly screened so as not to introduce an infection to the construction site and the wastes should be autoclaved and incinerated.
- In case of any disease outbreak vaccination should be performed in construction area or surroundings to prevent spread of disease, and
- Workers should cover as much of the body as feasible.

6.2.2.13. Community Health and Safety Impacts

i) Communicable Diseases

Communicable diseases pose a significant public health threat worldwide. Health hazards typically associated with development projects are those relating to poor sanitation and living conditions, sexual transmission, infectious diseases, and vector-borne infections.

The vaccine lab building will help stimulate local economy in its construction and operational phases. It will also help in improving the community health status and its ramification extends to productivity and economic growth. Despite this general fact, it also attracts patients from diverse areas and exposes local communities to diseases.

Communicable diseases of most concern during the construction phase are sexually transmitted diseases (STDs), such as HIV/AIDS and infectious diseases, such as COVID. Recognizing that no single measure is likely to be effective in the long term, successful initiatives typically involve a combination of behavioral and environmental modifications.

Extent of impact is limited to the construction and nearby areas and hence low. On the other hand, the impact is long lasting and hence high. Given that the project is within the hospital and awareness is better-off, incidence would be low. The duration is low, because the construction time is low. Receptors in some case are patients visiting the hospital and hence are sensitive. Hence impact significance is moderate.

Impact Significance

		Sensitivity of receptor			
		Very low	Low	Medium	High
		1	2	3	4
Intensity of impact	Very low 1	1 Negligible	2 Minor	3 Minor	4 Minor
	Low 2	2 Minor	4 Minor	6 Moderate	8 Moderate
	Medium 3	3 Minor	6 Moderate	9 Moderate	12 Major
	High 4	4 Minor	8 Moderate	12 Major	16 Major

Mitigation Measures for Communicable Diseases

- Contracting of an HIV service provider to be available on-site.
- Implementation of HIV/AIDS and COVID-19 education program.
- Information campaigns on STDs among the workers and local community.
- Education about the transmission of diseases.
- Vaccinating workers against common and locally prevalent diseases including COVID-19.
- Provision of condoms.
- Awareness rising about public health impacts from labor influx.
- Workers 'camp to include wastewater disposal and septic systems.
- Identification of authorized water supply source and prohibition of use from other community sources, and

Separate service providers for community and workers 'camp/construction site.

- Providing surveillance and active screening and treatment of workers
- Preventing illness among workers in local communities by:
- Undertaking health awareness and education initiatives, for example, encouraging condom use, provision of mask.
- Conducting immunization programs for workers in local communities to improve health and guard against infection.

Promoting collaboration with local authorities to enhance access of workers families and the community to public health services and promote immunization.

ii), Vector-Borne Diseases

Reducing the impact of vector-borne disease on the long-term health of workers is best accomplished through implementation of diverse interventions aimed at eliminating the factors that lead to disease. This vaccine lab building is in hot weather area and hence is prone to vector borne diseases. We had seen that malaria is a number one disease in prevalence.

Extent of impact is limited to the construction and nearby areas and hence low. On the other hand, the receptors in some case are patients visiting the hospital and hence are sensitive. Because the site is within the hospital compound, it is supposed that it will receive better vector control intervention and that would keep the impact low.

Impact Significance

		Sensitivity of receptor			
		Very low	Low	Medium	High
		1	2	3	4
Intensity of impact	Very low 1	1 Negligible	2 Minor	3 Minor	4 Minor
	Low 2	2 Minor	4 Minor	6 Moderate	8 Moderate
	Medium 3	3 Minor	6 Moderate	9 Moderate	12 Major
	High 4	4 Minor	8 Moderate	12 Major	16 Major

Mitigation measures for Vector-Borne Diseases

- Prevention of larval and adult propagation through sanitary improvements and elimination of breeding habitats in the project site.

- Elimination of unusable impounded water.
- Increase in water velocity in the channels.
- Implementation of integrated vector control programs.
- Promoting use of repellents, clothing, netting, and other barriers to prevent insect bites.

6.2.2.14. Social Impacts and Risks

A dispute may arise from the contractor and workers due to various reasons. Workers will develop non-harmonious relation among themselves and between the laborers and the contractor. In addition, there may be a conflict with the existing community dwellers due to the new way of life arising from the entry of construction related behaviors such as prostitution, sexual assault, and illegal drugs. As well, a frequency of grievance will be raised from workers related to working hours, access to essential materials for construction and wage limitation. Complaints may bay also arise from the local community if the contractor exclude them from temporary job opportunities, which consequently will lead to conflict and develop non-harmonious relation. Furthermore, a dispute because of religion and cultural needs may appear, since a lot of individuals will come to the area for tentative or permanent work.

i. Labour Influx

Labor influx in the project site may induce sex work and potential sexual relations between migrant workers and women and girls in the community. This may increase in risk of sexually transmitted diseases, such as HIV/AIDS etc. due to labor influx induced sex work and potential sexual relations between migrant workers and women and girls in the community. Workers, individually and collectively, will be susceptible to the corona virus as the construction works normally require teamwork(Pasco et al., 2020). It was estimated that allowing unrestricted construction work would be associated with an increase in the COVID-19 hospitalization rate from 0.38 per 1000 residents to 1.5 per 1000 residents overall.EPHI laboratory has highly infectious agents in storage, diagnosis process or culture. So, that there would be a possibility to escape infectious agents from the containment. Potential means for infectious agents to leave the existing containment and possibly cause human health impacts including construction workers by direct transmission, vector-born transmission, vehicle-borne transmission, air-born transmission, and water-born transmission.

ii. Gender Based Violence

There will be plenty of younger workers during the construction of vaccine lab, so that the potential risks emanating from the new social environment related to illegal and non-voluntary sexual relations. This situation will be exacerbated if the large influx of young male workers leads to an increase in exploitative sexual relationships and human trafficking whereby women and girls (working at institute) are forced into sex work during construction phase. Besides, the risk of GBV may be driven from the newly merging life of workers with the host comminity.

There is a potential risk of project workers engaging in illegal sexual relations with minor girls and high school students around the project site, leading to HIV infection, teenage pregnancy, illegal and risky abortions, school dropout, etc.

Mitigation Measures for Gender Based Violence

- The institution will prepare GBV prevention action plan and act accordingly.
- Conduct continued sensitization and awareness raising to construction worker in particular on prevention of GBV.
- The contractor will provide orientation to its staffs to respect the culture of the local people and to limit their relationship with the local people.
- Contractor and implementing agency to prepare and implement a GBV Prevention and Response Action Plan to include at minimum, in conformance with local laws and customs, equal opportunity for employment,
- All workers and nearby communities and stakeholders will be educated on preventing and responding to sexual harassment and GBV ahead of any project related works,
- Construction areas should be separated by fence and separate access gate is used for construction workers,
- Ensure that women are given a mentorship orientation before starting their work.
- Provision of gender disaggregated data, separate bathing, changing, sanitation facilities for men and women should be made ready by contractor, and
- Impose zero tolerance on sexual harassment, all forms of gender-based violence and discrimination at all phases of the project.

iii. Child Right Violation Impacts

During the construction stage, children may be exposed to permanently distort or disable their bodies when they carry heavy loads or are forced to adopt unnatural positions at work for long

hours. In addition, materials to be used for construction purpose would affect children playing in the surrounding area. Children are less resistant to diseases and suffer more readily from chemical hazards and radiation than adults.

In extreme situations, the rise in the number of young workers in the project area may lead children to be forced into sexual exploitation or recruitment by construction workers and Foreman, with no means to seek protection or justice. Children who have lost the care of their parents may also find it impossible to access essential services and lead to sexual abuses. Therefore, children of the surrounding community may experience insidious forms of violence, exploitation, and abuse during construction.

Mitigation measures for Child Right Violation

- Strengthen the social service workforce to identify and respond to potential situations of child labour through case management and social protection services, including early identification, registration and follow up,
- Improve children‘s access to justice systems that are child-friendly, gender-sensitive and well-resourced to uphold their rights, and
- Zero tolerance of child right violation and the contractor should inform for all workers related to child right violation consequences,
- The contractor is responsible to ensure that all workers should be over 18 years old (particularly for hazardous work) to comply with the contractor's obligation to prevent the use of child labor on the project,
- The contractor and his sub-contractors are expected to follow standard occupational health and safety standards during the construction phase of the project.

The following mitigation methods need to be implemented by the contractors/subcontractor to prevent child labor:

- ☛ The contractor should clearly state the minimum age for general work in their hiring policy and job announcements
- ☛ Hiring procedures and processes must include a robust age verification mechanism, which includes checking ID documents (government-issued ID) and in-person interviews

6.2.2.15. Impacts associated with use of poor-quality construction materials

Use of poor-quality construction materials can cause wide ranging impacts such as fire hazard, building collapse, physical injury to staff and patients.

Extent of impact is limited to the construction and nearby areas and hence low. On the other hand, the receptors may be patients visiting the facility and staffs hence are sensitive. The impact can happen at any time in the life span of the building. In most case such impacts are progressive and hence can be seen/ detected and that would keep the impact low.

Impact Significance

		Sensitivity of receptor			
		Very low	Low	Medium	High
		1	2	3	4
Intensity of impact	Very low 1	1 Negligible	2 Minor	3 Minor	4 Minor
	Low 2	2 Minor	4 Minor	6 Moderate	8 Moderate
	Medium 3	3 Minor	6 Moderate	9 Moderate	12 Major
	High 4	4 Minor	8 Moderate	12 Major	16 Major

Mitigation measures Impacts associated with use of poor-quality construction materials

Construction materials should be of the appropriate quality, specifications, and standards. This can be ensured through:

- Provision of materials from licensed dealers and suppliers who are compliant especially with environmental requirements. Quality should be thoroughly controlled through regular tests. No construction material should be sourced from unlicensed dealers. As stated in EHSG 2.0, (Occupational health and safety) companies need to hire contractors that have the technical capability to manage the occupational health and safety issues of their employees, extending the application of the hazard management activities through formal procurement agreements.
- As describedin Ethiopian Building Proclamation (Proc. No. 624/2009)sub article 53, contractor must not use improper materials or defective workmanship in construction

- Procurement of the materials which follow specifications by the structural engineers and architects.
- All construction materials' waste should be removed and disposed from the site
- All construction materials/equipment should be removed from the site.
- Construction camps and materials sites need to be restored back to their original conditions upon project completion. Any borrow pits/quarries created as a result of the proposed project should be restored. The contractor should review the site management plan such as to cover the operations and restoration (site decommissioning) upon project completion.
- Landscaping of project site and introducing vegetation that matches with the buildings.
- Ensure compliance with established sand harvesting regulations. If sand is obtained through independent suppliers, the contractor should ensure due diligence on abstraction and haulage.

6.2.2.16. Chance Finds

- According to the World Bank's safeguards policy on Physical Cultural Resources - PCR (BP 4.11), the borrower (represented by MOH) shall inform the Bank of the relevant requirements of its legislation and of its procedures for identifying and mitigating potential impacts on physical cultural resources, including provisions for monitoring such impacts, and or for managing chance finds; be responsible for siting and designing the project to avoid significant adverse impacts to cultural heritage. In the case of the proposed project, the MOH and EFDA will observe the chance finds procedure (see section 10.1) that would be incorporated into the contractor's contractual agreement.

6.3. Operation Phase

6.3.1. Operation Phase Positive Impacts

i. Improved medical surveillance services

The vaccine lab building project will positively impact the health sector of the country. The vaccine lab building, as an essential and fundamental part of all health systems, will ensuring the safety, quality and efficacy or performance as applicable of all food, medicines, medical devices, and other supplies that are used in the health care system of a country. It will also strengthen local food & pharmaceuticals manufacturing industries and enable the country and regulatory authorities in the region to cope with the dramatic changes in pharmaceutical

technologies and control of SSFFCs and modernize the regulatory practices in the region. Its ramification extends to health security, national economies as well as the health and wellbeing of individuals.

Enhancement measures: Appropriate staffing with technical/medical personnel adequately trained in use of newly installed equipment. Equipping the lab facility with sufficient laboratory infrastructures would help to enhance benefits of the lab.

ii. Employment opportunities

Operation of the Vaccine Laboratory will create job opportunity for permanent technical and non-technical staffs.

Enhancement measure: Wherever feasible, qualified people from the country should be considered for job opportunities. When it comes to employment, the project needs to observe those privileges and affirmative actions specified in labor proclamation (Proclamation No 1156/2019) article 87 and 88 for women. Giving priority to women workers will contribute to reducing the dependency of women on men and encourages women to learn new skills. The proposed project will create skilled, unskilled and semi-skilled jobs. This would be a positive impact lasting through the operation phases.

iii. Protect and Promote Community Health

The EFDA has been undertaking quality testing of food products, efficacy of drug and vaccine and performance of medical equipment and researching, based on national public health research agenda, on priority food and drug quality problems, and generate, absorb, and disseminate scientific and technological knowledge to improve the health of the general public. It has been conducting surveillance for the early identification and detection of public health risks and prevents public health problems through adequate preparedness; and alert, warn and dispatch timely information, respond effectively and timely and ensure rapid measures on adulterated and polluted food and drug products. The EFDA has been striving to strengthen its laboratories with trained manpower and technology to undertake problem solving researches provide effective response to public health problems and testing quality of drug and food at the national level to enable them provide quality laboratory services.

Therefore, the implementations of Vaccine lab EFDA will transform the above services and objectives of the sector through developments of adequate laboratory infrastructures, which

enable the EFDA to have effective quality laboratory system, and training researchers and practitioners for best public health interventions.

Enhancement Measures: The facility should construct as per WHO standard and hiring the right construction agency for the construction of Vaccine lab at EFDA is the key step for the success of the project. The EFDA Vaccine lab would be operated according to all guidance and requirements established by the CDC and NIH (CDC 1999; WHO, 2004).

iv. Regional Integration

A regional approach to developing the Vaccine Lab project can have several benefits, including facilitating mobility of people and skilled labor, promoting peer learning among countries and institutions and sharing good policies and practices, and targeting employment toward regional economic corridors. The regional integration facilitating the flow of human capital and ideas and promote medical tourism in the region.

Enhancement measures: The EFDA should promote mobility of people and skilled labor. EFDA should identify skills gaps and developing cross-border skills enhancement programs. In simple terms, the extent to which countries and regions will benefit from regional and global value chains depends on the skills of their populations: more precisely, on how well workers' competencies match the technology and research capacities of today and tomorrow.

v. Other positive impacts

The proposed project will contribute towards increase in revenue collection by the government. The proposed project will be connected to the existing public utilities hence will generate revenue to the water and power companies through payment of connection and service fees. It will also help in enhancing image of the regional government.

6.3.2. Operation Phase Environmental Impacts and Risks

6.3.2.1. Impacts Associated with Waste Collection

Waste from the vaccine lab can be divided into two separate groups: General waste, similar in composition to domestic waste, generated during administrative, housekeeping, and maintenance functions; and Hazardous health care waste that includes Infectious waste, sharps, cultures, blood and body fluids, pathological wastes, wastes generated from patients in isolation, pharmaceutical wastes and genotoxic/cytotoxic wastes.

Though hazardous wastes account smaller proportion of the total waste, about 15%-25%, it could expose the healthcare workers, waste handlers and the community to infections. Thus, risks associated with waste management are expected during waste collection, storage, transport, treatment and disposal.

When the vaccine lab starts to operate, it will generate solid and liquid wastes on a daily base. Part of generated wastes would be infectious; and part of the waste would be non-hazardous waste. Therefore, improper handling, treatment and disposal of waste can cause serious health problem for workers, the community and environment. These constitute a risk, if they are not properly handled, treated or disposed and/or allowed to get mixed with other municipal waste.

When it comes to the duration, the impact would be long-term (it is there as long as the laboratory functions). The spatial extent is local affecting laboratory workers and members of the public (patients). Given the high-level awareness, the likelihood of the impact happening would be low. If it happens, the impact would be medium. Sensitivity on the receptors side is high; hence the impact significance is moderate.

Impact significance

		Sensitivity of receptor			
		Very low	Low	Medium	High
		1	2	3	4
Intensity of impact	Very low 1	1 Negligible	2 Minor	3 Minor	4 Minor
	Low 2	2 Minor	4 Minor	6 Moderate	8 Moderate
	Medium 3	3 Minor	6 Moderate	9 Moderate	12 Major
	High 4	4 Minor	8 Moderate	12 Major	16 Major

Mitigation measures for impacts associated with waste collection

The Vaccine Laboratory should adhere to the application of the Ethiopia Healthcare Waste Management National Guideline (FMOH, 2008); WHO Laboratory Biosafety Manual 3rd edition (WHO, 2004) and WBG EHS Guidelines (WBG, 2007) which represent best practices.

- Develop and implement a waste management plan that is implementable on a daily base.

- Initial packaging and storage should take place at site of generation.
- Storage of waste should then move to a temporary on-site storage location.
- Non-risk waste should be stored in a separate location from the infectious/ hazardous wastes in order to avoid cross-contamination.
- Strengthen the internal waste management system with additional facilities to ease collection and segregation at source.
- All used sharps should be autoclaved prior to incineration.
- Sharps should be placed in rigid, puncture-resistant containers made of glass, metal, rigid plastic.
- Liquid infectious wastes should be placed in capped or tightly closed bottles or flasks.
- Solid or semi-solid wastes should be placed in tear-resistant plastic bags.
- There would be special packaging characteristics for some treatment techniques: incineration requires combustible containers, and steam sterilization requires packaging materials that allow steam penetration and evacuation of air.
- Solid waste generated in the laboratory should leave the laboratories only after decontamination.
- Non-hazardous wastes that are generated should be incinerated.
- Liquid waste discharged from laboratory should be treated chemically prior to release to the waste tank.
- Appropriate waste bins (color coded) should be provided for the different types of waste to allow segregation and collection at point of generation.
- The autoclave should be maintained and calibrated regularly.
- Waste should be removed at least once in 24 hours and incinerated.
- Laboratory staff and all other staff involved in waste handling should be trained on the waste handling treatment, and disposal techniques.
- Fumigation of the laboratory by disinfectant gases would be conducted according to WHO laboratory manual.
- Regular visual inspection of all waste collection and storage areas should be made for evidence of accidental releases and to verify that wastes are properly labeled and stored.
- Regular audits of waste segregation and collection practices need to be made.

- Tracking of waste generation trends by type and amount of waste generated, preferably by facility departments is mandatory.
- Keep records of waste generated and its destination.

6.3.2.2. Impacts Associated with Transportation of Waste

Transport of infectious and potentially infectious materials should be as described in Healthcare Waste Management National Guideline 2008, WHO Laboratory Biosafety Manual 3rd edition and WBG EHS Guidelines.

Compliance with the guideline will:

- Reduce the likelihood that packages will be damaged and leaked.
- Reduce the exposures resulting in possible infections; and,
- Improve the efficiency of package delivery.

During transportation, waste could be released from the container or bags due to poor handling or packaging. These wastes may contain potentially harmful microorganisms that can infect health workers, patients and the general public as well as the environment. Other potential hazards may include drug-resistant microorganisms which spread from health facilities into the environment. So, the adverse health outcomes associated with health care waste transportation would be spread of infectious agents and sharps-inflicted injuries.

Duration of the impact would be long-term (it is there as long as the laboratory functions). The spatial extent is local affecting laboratory workers and members of the public (patients). Given the high level of awareness, the likelihood of the impact to happen would be low. If it happens the impact would be medium. Sensitivity on the receptors side is high; hence the impact significance is moderate.

Impact significance

		Sensitivity of receptor			
		Very low 1	Low 2	Medium 3	High 4
Intensity of impact	Very low 1	1 Negligible	2 Minor	3 Minor	4 Minor
	Low 2	2 Minor	4 Minor	6 Moderate	8 Moderate
	Medium 3	3 Minor	6 Moderate	9 Moderate	12 Major

High	4	4 Minor	8 Moderate	12 Major	16 Major

Mitigation Strategies for risks associated with waste transportation

- Transportation of waste should take place during non-pick hours.
- Set routes should be used to prevent exposure to staff and patients and to minimize the passage of loaded carts through patient care and other clean areas.
- Carts, trolley, or containers used for the transportation of infectious waste should not be used for the transportation of any other material.
- Waste that has the potential to leak should be double bagged.
- Waste bags would be placed in containers (cardboard boxes or wheeled, rigid, lidded plastic or galvanized bins), before being placed directly into the transportation vehicle.
- The collected waste will not be left even temporarily anywhere other than at the designated storage room.
- Containers would be covered with lids during storage and transport.
- The internal transportation of waste should use separate floors,
- Regular transport routes and collection times should be fixed and reliable.
- Transport staff should wear adequate personal protective equipment (PPE) including gloves, closed shoes, overalls, and masks.
- Education and training should be provided to all waste transport workers.
- A bulky and heavy waste should be transported by using wheeled trolleys or carts that are not used for any other purpose.
- Waste, especially hazardous waste, would never be transported by hand due to the risk of accident or injury from infectious material.
- The vehicles would be thoroughly cleaned and disinfected daily as per a written protocol.
- Separate routes for transporting hazardous and non-hazardous waste would be used.
- In general, a waste route would follow the principle from clean to dirty.
- Collection would start from the most hygienically sensitive laboratory area.

6.3.2.3. Waste Disposal Impact

The disposal and storage of complex health care wastes without treatment can lead to contamination of surface and groundwater through long term leachate accumulation from the disposal sites. This can ultimately disturb the ecological and environmental balance. Wastes

generated from different processes are of complex characteristics and composition and hence, their safe management and disposal is also complex. The characteristic of these wastes is that they are rich with heavy metals such as Zn and Cr.

Heavy metals in the waste usually present as metal oxides, metal elements, volatile metallic chlorides, and sulphates. Most heavy metals migrate or concentrate in the fly ash and bottom ash, depending on the formed compounds of heavy metals and their physicochemical properties during incineration. Human health risks due to dioxin and furan exposure have been reported and evidence for dioxin and furan toxicity in humans comes from studies of populations that have history of exposure. Heavy metals released from the waste are toxic and mutagenic.

During the operation wastes will be generated, and they should be treated using different techniques such as autoclave, chemical disinfectant, incinerators. Duration of the impact would be long-term. The spatial extent is local affecting laboratory workers and members of the public (patients). Given the low efficiency of the incinerator, the impact will be medium. In addition, the likelihood of the impact to happen would be medium. Sensitivity on the receptors side is medium; hence the impact significance is moderate.

Impact Significance

		Sensitivity of receptor			
		Very low	Low	Medium	High
		1	2	3	4
Intensity of impact	Very low 1	1 Negligible	2 Minor	3 Minor	4 Minor
	Low 2	2 Minor	4 Minor	6 Moderate	8 Moderate
	Medium 3	3 Minor	6 Moderate	9 Moderate	12 Major
	High 4	4 Minor	8 Moderate	12 Major	16 Major

Mitigation methods for risk associated with waste disposal

- Personnel working on waste disposable should wear adequate PPE including gloves, closed shoes, overall and mask.
- Training should be provided to personnel working on waste disposable.

- Bottom ash should be managed separately from fly ash and other flue gas treatment residues to avoid contamination of the bottom ash for its potential recovery.
- Bottom ash and residuals should be managed based on their classification as hazardous or nonhazardous materials.
- Hazardous ash should be managed and disposed of as hazardous waste. These wastes are predominantly hazardous wastes and would be disposed of in safe landfills, and the landfilling should be in proper double-walled containers; and,
- Waste disposal system should be monitored periodically.

6.3.2.4. Spillage Impact

Diverse chemicals (including the infectious one) may spill in the laboratory and cause variable impact.

Duration of the impact would be long-term. The spatial extent is local, affecting laboratory workers and members of the public (patients). If it happens, the impact will be medium and the likelihood of the impact to happen would be medium. Sensitivity on the receptors side is medium; hence the impact significance is moderate.

Impact significance

		Sensitivity of receptor			
		Very low 1	Low 2	Medium 3	High 4
Intensity of impact	Very low 1	1 Negligible	2 Minor	3 Minor	4 Minor
	Low 2	2 Minor	4 Minor	6 Moderate	8 Moderate
	Medium 3	3 Minor	6 Moderate	9 Moderate	12 Major
	High 4	4 Minor	8 Moderate	12 Major	16 Major

Mitigation measures for Impacts associated with spillage

In the event of a spill of infectious or potentially infectious material, the following spill clean-up procedure should be used.

- Wear gloves and protective clothing, including face and eye protection if indicated.
- Cover the spill with cloth or paper towels to contain it.

- Pour an appropriate disinfectant over the paper towels and the immediately surrounding area (generally, 5% bleach solutions are appropriate.
- Apply disinfectant concentrically beginning at the outer margin of the spill area, working toward the center.
- After the appropriate amount of time (e.g. 30 min), clear away the materials. If there is broken glass or other sharps involved, use a dustpan or a piece of stiff cardboard to collect the material and deposit it into a puncture-resistant container for disposal.
- Clean and disinfect the area of the spillage (if necessary, repeat the above steps).
- Dispose of contaminated materials into a leak-proof, puncture-resistant waste disposal container.
- After successful disinfection, inform the competent authority that the site has now been decontaminated.

6.3.2.5. Improper Wastewater Treatment Impact

There are risk factors which can jeopardize the efficiency of the treatment plant. The risk can originate from the design or operation. The design phase risks comprise such factors as inadequate tank volume, geometry and compartmentalization, inconsideration of tank access space and plan that involves the use of substandard construction materials. In addition, a faulty designing can result also in cracking of the tank, leakage, infiltration, tank flotation and inadequate retention time of effluent. Moreover, scums, seepage and sludge can clog the treatment plant drainage system. On the other hand, similar problems can reduce the efficiency of sand/media filters. For instance, low retention time, poor aeration, improper pore size distribution are risk factors that can hamper efficiency of sand media filter.

When it comes to the duration, design fault is long lasting. Extent of impact is local and impact on the quality of ground water table, soil and receiving surface water is medium. However, if proper risk mitigation strategies are in place and with the current good septic tank design consideration, the probability that the impact would happen is low. Thus, impact significance is moderate.

Impact significance

	Sensitivity of receptor			
	Very low	Low	Medium	High
	1	2	3	4

Intensity of impact					
	Very low 1	1 Negligible	2 Minor	3 Minor	4 Minor
	Low 2	2 Minor	4 Minor	6 Moderate	8 Moderate
	Medium 3	3 Minor	6 Moderate	9 Moderate	12 Major
	High 4	4 Minor	8 Moderate	12 Major	16 Major

Mitigation strategies for impact of wastewater treatment plant, Septic tank, and sand/media filters operation

- Proper tank volume, geometry, and compartmentalization to impart adequate hydraulic residence time for sedimentation should be considered.
- Elongated tanks with length-to-width ratios of 3:1 or more should be used to reduce short-circuiting of the effluent.
- Two compartments should be used to achieve, better suspended solids removal rates.
- Manway of 18 to 24 inches in diameter or square should be designed to access the tank for regular monitoring and maintenance.
- Use prefab, pre-cast concrete, fiberglass, polyethylene, and coated steel tanks.
- Tank joints should be designed for water-tight tank and should be located where it can be accessed easily for seepage removal and sited away from drainage lines or depressions where water can collect
- Maintaining minimum horizontal setback distances from buildings,property boundaries, wells, water lines, and thetank should rest on uniform bearing surface.
- The backfill material should be free flowing and free of stones larger than 3 inches in diameter and debris.
- Joints should be sealed properly, including tank joints.
- Use appropriate anti-flotation devices.
- Tanks should be pumped when sludge and scum accumulations exceed 30 percent of the tank volume or are encroaching on the inlet and outlet baffle entrances.

Periodic pumping of septic tanks needs to be used to ensure proper system performance and reduce the risk of hydraulic failure. They should be pumped every 3 to 5 years depending on the size of the tank.

6.3.2.6. Air Emission

Incineration of hospital waste if carried out in inappropriate facilities could result into localized pollution of air with pollutants such as ash, furans, and dioxins. Dioxins are known to promote cancers in humans. The downwash of incinerator emissions has potential to degrade indoor air quality of healthcare buildings or those of nearby offsite buildings. The impact severity associated with this is that the duration of onsite and offsite air pollution would be long-term lasting entire life on incineration units unless the deficient units are either decommissioned or improved. Considering the gravity of potential air pollution on health of patients and nearby communities, this impact will have high significance.

The incinerator proposed in this project will focus on the technology having lower emission reduction device control and also incorporated with parallel dedusting, lower contamination of filter dusts. if the proper risk mitigation strategies are in place and with selecting good incinerator technology, the probability that the impact would happen is low. Thus, impact significance is moderate.

Impact significance:

		Sensitivity of receptor			
		Very low	Low	Medium	High
		1	2	3	4
Intensity of impact	Very low 1	1 Negligible	2 Minor	3 Minor	4 Minor
	Low 2	2 Minor	4 Minor	6 Moderate	8 Moderate
	Medium 3	3 Minor	6 Moderate	9 Moderate	12 Major
	High 4	4 Minor	8 Moderate	12 Major	16 Major

Mitigation measures of air emission

→ Controlled procurement process to ensure quality and efficient incinerators,

→ Prohibit open burning of medical waste on site,

→ Siting of the incinerators should be away from the health facilities wards, residential areas and farms.

→ Training should be providing for incinerator operators as it is important for them tobe familiar with basic principles and routine practices.

→ Homogenization of waste is crucial to ensure efficient and complete combustion during incineration to avoid generation of dioxins for instance when wet waste batches quench flames and lower combustion temperature below levels at which such pollutants are destroyed.

6.3.2.7. Impacts on Ecological Resources and Biodiversity

The Vaccine Lab in its operational phase will have little effects on biodiversity. Infectious microorganisms handled in the proposed laboratory might be introduced into the environment under two different ways. The first is in the disposal of sanitary wastewater and the second possible route in emergency situations. If microbes escape, there is a high possibility that environmental factors would kill microorganisms in the vegetative state. That includes ultraviolet light, dehydration, high temperatures, freezing temperatures, and the presence of free oxygen. The survival or death curves indicate that microbial populations die off quickly (DA 1989). Extent of this impact could have long effects to wildlife species in the immediate site location area. Given that the microbes that would be studied in Vaccine Lab are not microbes with high risk factor; their impact would be low if escaped. The extent of impact will also be low. The sensitivity of the receptors is rated medium. Hence significance of the impact is moderate.

Impact significance:

		Sensitivity of receptor			
		Very low	Low	Medium	High
		1	2	3	4
Intensity of impact	Very low 1	1 Negligible	2 Minor	3 Minor	4 Minor
	Low 2	2 Minor	4 Minor	6 Moderate	8 Moderate
	Medium 3	3 Minor	6 Moderate	9 Moderate	12 Major
	High 4	4 Minor	8 Moderate	12 Major	16 Major

Mitigation measures for impacts on biodiversity

- Personnel working on the Vaccine Lab need to be trained on emergency preparedness and responses as well as in handling of infectious materials and waste management during accidents / emergencies.

6.3.2.8. Utility (Water and Energy) Impacts

Use of HAVAC system, deep freezer, steam sterilizer, autoclave and other laboratory equipment, installation of new incinerator requires additional energy demand and create pressure on local energy requirements. In addition, water will be also required for sanitation and drinking during operation phase.

The probability that such would happen is very low. Duration of impact is long lasting. Extent of impact is local, and impact is medium. Sensitivity of receptors is medium. Thus, impact significance is minor.

Impact significance

		Sensitivity of receptor			
		Very low 1	Low 2	Medium 3	High 4
Intensity of impact	Very low 1	1 Negligible	2 Minor	3 Minor	4 Minor
	Low 2	2 Minor	4 Minor	6 Moderate	8 Moderate
	Medium 3	3 Minor	6 Moderate	9 Moderate	12 Major
	High 4	4 Minor	8 Moderate	12 Major	16 Major

Utility Impacts (Water and Energy) Mitigation Measures

- Reduce heating, cooling, and lighting demand through passive strategies such as climate-responsive design, day lighting, and conservation practices.
- Employ renewable energy sources such as solar for road lightening in the future,
- The institute should implement water conservation program such as Good housekeeping measures, and use of Automatic Shut-off Valves.
- Use alternative groundwater source during operation phase.

6.3.3. Occupational Health and Safety Impact

Operating the proposed Vaccine laboratory involves handling of infectious organisms. However, there has been extremely low incidence of laboratory-acquired infections associated

with operations in CDC-registered laboratories since the implementation of CDC developed guidelines issued in 1974. The most obvious potential concern of operating the proposed Vaccine laboratory involves testing of food, drug and medical equipment's. It will have attributes of most laboratories in that it would have identified physical, electrical, biological and chemical hazards. It would not use radioactive materials, propellants, or high explosive materials, and the quantities of hazardous chemicals stored in the lab at any one time would be just a few liters each of chemical disinfectants (such as sodium hypochlorite or potassium hypochlorite) and biologic stabilizers (phenol).The potential for injuries and illnesses involving routine laboratory operations presents a greater health risk to workers than does the potential for injury and illnesses associated with handling infectious substances at the proposed BSL 3 laboratory would hand highly infectious agents.

6.3.3.1. Chemical Hazards

i) Chemical impact

Some chemicals adversely affect the health of those who handle them or inhale their vapors. Chemical disinfectants (such as sodium hypochlorite or potassium hypochlorite) and biologic stabilizers (phenol). Chemicals such as paraformal dehyde used for fumigation. Apart from overt poisons, several chemicals are known to have various toxic effects on workers. The respiratory system, blood, liver, kidneys and the gastrointestinal system, as well as other organs and tissues may be adversely affected or seriously damaged. Some chemicals are known to be carcinogenic or teratogenicity

The hazardous chemicals used and stored will be tracked using computerized chemical inventory system and handled according to international good practices (Kuzmina et al., 2022). There would be no apparent public human health effect from routine Vaccine Lab facility complex. The combination of utilizing the guidelines, standards, practices, and procedures established by the CDC, NIH, WHO together with vaccine labsafety equipment and facility safety barriers, results in an overall potential risk of illness to site workers or visitors from operations involving select agents that would be best characterized as minor.

Chemical Hazards Mitigation Measures

- To avoid accidental leakage or spillage, secondary containers, such as leak-proofboxes, should be used, fitted with racks so that the specimen containers remain upright,

- Respiratory protection should be used when carrying out high-hazard procedures. The choice of respirator will depend on the type of hazard(s), and it be available with interchangeable filters for protection against gases, vapors, particulates and microorganisms
- Volatile solvents should be handled in chemical hood,
- Material Safety Data Sheets (MSDS) or equivalent should be considered while handling, storing, using, and disposing hazardous chemicals.
- Only small amounts of chemicals necessary for daily use should be stored in the laboratory,
- Where corrosive, oxidizing, or reactive chemicals are used, handled, or stored, qualified first-aid would always be ensured. Appropriately equipped first-aid stations would be easily accessible throughout the place of work, and eye-wash stations and/or emergency showers should be provided close to all workstations where the recommended first-aid response is immediate flushing with water,
- Either a fully buttoned laboratory coats, gowns, coveralls, or a long-sleeved, back opening gowns or coveralls should be used in vaccine laboratory. Aprons may also be worn over laboratory coats or gowns where necessary to give further protection during handling of chemicals, hazardous and infectious materials, and
    - Eye and face protection (goggles, mask, face shield or other splash guard) would be used for anticipated splashes or sprays of infectious or other hazardous chemical materials.
    - The facility should assign designated personnel (safety officer) who would regularly follow the appropriateness of chemical utilization, chemical incompatibility during storage and the overall chemical safety practice.
    - Chemical likeparaformaldehyde would not be stored in the lab but brought in only when required for fumigation (the facility has a minimal amount of storage space).

ii) Impact of Chemical Storage in Warehouse

The warehouse will store diverse chemicals because the lab uses chemicals in variable amounts and must therefore store them. It will also store/hold obsolete chemical before disposal. Acting as a warehouse, the storage facility also shelters the chemicals: it protects the personnel and the environment from the effects of a spill, or an aerosol or gas emission.

Chemical emissions: Toxicological, chemical, and physical properties define the hazards of a chemical. However, in a chemical storage facility further factor add on: quantity, storage form, proximity of various chemicals, activities carried out in the facility, etc. The following example illustrates this hazard increase: hydrochloric acid and iron fillings, stored separately, are not flammable, yet when they come in contact, their reaction releases hydrogen, an extremely flammable gas, which may cause fire or explosion. But the hazard first materializes, when chemicals are spilt, e.g. out of containers. Among numerous causes for a chemical leak are:

- Mechanical damage of the container (bumped during transportation, tilted over after it was placed on an unstable ground or rack.
- Container ageing (plastic becoming brittle with time or under the effect of light or temperatures, plastic softening through heat, metal corrosion, interaction between the container and its filling).
- Expansion of the filling (vapor pressure build-up with heat, crystallization at low temperature, chemical decomposition with time or induced by light exposure).
- Sampling and transfer of chemicals.

This chemical dispersion can have consequences for health of the staff community and environment as follow:

Damage to health: A leaked chemical, especially when it is volatile or a gas at room temperature can cause intoxication. The risk of intoxication is particularly insidious, when the spilt chemical on its own does not have any severe toxicological property but releases a toxic substance when it reacts with the environment or other chemicals stored in the same room (for instance, gaseous chlorine forms, when liquid bleach comes in contact with an acidic solution) will have hazardous nature. Besides these acute effects, a wide range of chronic effects can also occur (such as impaired organ function, allergies and cancers. Contrary to acute effects, the occurrence of those chronic effects does not necessarily depend on the level of exposure: allergies, for example, can be triggered by exposure to very low concentrations of a sensitizing agent. Moreover, among all chemicals categories, liquefied gases constitute a specific hazard. Contact with liquefied gases causes severe frostbites and, even if not toxic, once released, their rapid expansion can locally reduce the oxygen concentration to dangerously low levels and therefore cause asphyxia.

Damage to the environment and facilities: Apart from the hazards they represent for workers' health, stored chemicals may induce hazards for facilities, fauna and flora, and the general public off site. When they are spilled, chemicals can irreversibly alter soils, streams and ground waters, thus affecting surrounding communities. The nature of the environmental damage caused by a chemical spill depends on its toxicological, physical, and chemical properties (form, reactivity, solubility, persistence, bioaccumulation, etc.) and those of the polluted site (permeation properties, etc.). The risk of pollution increases with the amount of stored chemicals.

Stored chemicals can also cause accidental fire or explosions account for few occupational accidents each year. However, when they happen, they often claim lives and have environmental and economic consequences. Hostile fire is an uncontrolled oxidation reaction between combustible matter and an oxidant. Large amounts of both elements can often be found in a storage facility. Oxygen is the usual oxidant involved in fire, while stored goods (organic chemicals like solvents or polymer pellets), packaging materials (plastic bags or containers) or pallets act as combustible matter. Various sources of energy can start a fire, e.g. a spark, heat, an explosion. Accidental explosions can be either "physical" or "chemical". A physical explosion can happen when, for example, pressure builds up inside a chemical container. Chemical explosions result from chemical reactions: a decomposition (storage of explosive materials) or the inflammation of an explosive atmosphere (storage of flammable chemicals, of oxidizing metal dust, etc.). In some cases, the chemical reaction is essentially combustion. Many dusts of combustible materials as diverse as flour and coal, can lead to a risk of explosion at critical concentrations in the air.

Risk associated with warehouse may result from handling of chemicals. The warehouse project operators should have procedure to prevent chemical and materials hazards. This control measures would be designed and implemented accordingly, and the institute would continue providing training on the appropriate usage, handling and storage of chemicals and hazardous substances.

Chemical hazards can most effectively be prevented through a hierarchical approach that includes designing a chemical storage facility. This is vaccine Laboratory and hence uses some amount of chemical and hazardous materials for different purposes. Professional staffs need to have regular training in handling of chemicals and hazardous materials. Chemical hazards represent potential for illness or injury due to single acute exposure or chronic

repetitive exposure to toxic, corrosive, sensitizing or oxidative substances. They also represent a risk of uncontrolled reaction, including the risk of fire and explosion, if incompatible chemicals are inadvertently mixed.

The risk of the accidents due to chemical and hazardous materials would be low at warehouse. Duration of the impact would be long-term, lasting through the entire life of the affected person, or short-term depending on the hazard the person in question is exposed to. The intensity of the impact is low if appropriate facility design is adopted, and PPE used by workers. However, sensitivity on the receptors will be high; hence the impact significance is moderate.

Impact significance

		Sensitivity of receptor			
		Very low 1	Low 2	Medium 3	High 4
Intensity of impact	Very low 1	1 Negligible	2 Minor	3 Minor	4 Minor
	Low 2	2 Minor	4 Minor	6 Moderate	8 Moderate
	Medium 3	3 Minor	6 Moderate	9 Moderate	12 Major
	High 4	4 Minor	8 Moderate	12 Major	16 Major

Mitigation measures for Impact of Chemical Storage in Warehouse

International Chemical Safety Cards (ICSC), WBG EHS Guideline and Laboratory Biosafety Manual 3rd edition, recommends the following mitigation strategies will be implemented:

- Replacement of the highly hazardous substances with a less hazardous one.
- Implementation of engineering and administrative control measures to avoid or minimize the release of hazardous substances into the work environment and keeping the level of exposure below internationally established or recognized limits.
- Where corrosive, oxidizing, or reactive chemicals are used, handled, or stored, qualified first-aid would always be ensured. Appropriately equipped first-aid stations would be easily accessible throughout the place of work, and eye-wash stations and/or emergency showers would be provided close to all workstations where the recommended first-aid response is immediate flushing with water.

- Keeping the number of employees' exposure to hazardous substances to a minimum.
- Communicating chemical hazards to workers through labelling and marking according to national and internationally recognized requirements and standards including the Material Safety Data Sheets (MSDS) or equivalent. Any means of written communication would be in an easily understood language and be readily available to exposed workers and first-aid personnel.
- Training workers in the use of the available information (such as MSDSs), safe work practices, and appropriate use of PPE.

OSHA's recommendations also need to be observed that are mentioned hereunder:

- Read chemical labels and MSDSs for specific storage instructions.
- Store chemicals in a well-ventilated area; however, do not store chemicals in a fume hood
- Maintain an inventory of all chemicals in storage.
- Return chemical containers to their proper storage location after use.
- Store glass chemical containers so that they are unlikely to be broken.
- Store all hazardous chemicals below eye level.
- Never store hazardous chemicals in a public area or corridor.
- Separate acids from bases. Store these chemicals near floor level.
- Isolate perchloric acid from organic materials. Do not store perchloric acid on a wooden shelf.
- Separate highly toxic chemicals and carcinogens from all other chemicals. This storage location should have a warning label and should be locked.
- Separate acids from flammables.
- Do not keep peroxide-forming chemicals longer than twelve months.
- Do not allow picric acid to dry out.
- If flammables need to be chilled, store them in a laboratory-safe refrigerator, not in a standard refrigerator.
- Flammables would be stored in a flammable storage cabinet.
- Store reactive materials separate from corrosives or flammables.
- Store Nitric acid (reactive and corrosive) separately from other acids and flammables.
- Storage location should clearly indicate which group/code is stored in that location. Each shelf or cabinet should indicate the color.

- Each chemical container should be clearly labelled by its storage color.

iii) Impact of Fire and explosion Outbreak

Combustible materials such as flammable liquids, solid materials and loose electrical connections could cause serious fire incidents in the laboratory complex facility and warehouse. Flammable liquids are volatile in nature and liberate vapors at ambient or elevated temperatures that can ignite in presence of sparks, hot plates, naked flames or other hot surfaces. This incidence may cause a serious injury to the workers even may be life treating.

There is a risk of fire outbreak in the laboratory. Duration of the impact would be long-term, lasting entire life of laboratory operation phase, local in spatial extent affecting onsite facilities, patients, lab workers and neighboring communities with possibly irreversible impact. The likelihood of the impact occurring is low given the proper design, presence of trained staff and implementation of regular fire safety precautions. Sensitivity of the receptors is medium given that there is emergency exit and staffs are trained, hence impact significance is moderate.

Impact significance

		Sensitivity of receptor			
		Very low 1	Low 2	Medium 3	High 4
Intensity of impact	Very low 1	1 Negligible	2 Minor	3 Minor	4 Minor
	Low 2	2 Minor	4 Minor	6 Moderate	8 Moderate
	Medium 3	3 Minor	6 Moderate	9 Moderate	12 Major
	High 4	4 Minor	8 Moderate	12 Major	16 Major

Mitigation measures for impact of fire outbreak

The proposed project would adhere to the application of salient practices from the WBG EHS Guidelines for Community Health and Safety and in section Life and Fire Safety and WHO Laboratory Biosafety Manuals 3rd edition. Mitigation measures for impact of fire outbreak are as follow:

- Fire extinguishers should be available in accessible area near to fire risk area and ensure that all fire-fighting equipment is regularly maintained and serviced.
- All staff needs to have training in fire control through regular firefighting drills.
- Fire emergency telephone numbers should be displayed in communal areas.
- Automatic fire alarm system for the entire laboratory should be installed.
- Fire suppression for the vaccine lab facility would be provided by a standard wet-pipe fire sprinkler system,
- Water flow alarms should be connected to the facilities fire alarm monitoring station so that designated responders would be notified.
- Prepare a fire safety plan and the plan should provide employees or building occupants with the instructions they need to leave the building (or respond as appropriate) in the event of a fire.
- Delineating fire and emergency assembly points and creating awareness to ensure all people at site are aware of them,through the use maps on elevators, staircases etc.
- All laboratory electrical equipment would be earthed/grounded, preferably through three-prong plugs.
- Combustible materials such as flammable liquids, solid materials should be stored in lockable cupboard.
- Fire hazard signs such as 'No Smoking' signs will be provided. Directions to exit in case of any fire incidence and emergency contact numbers will be provided. The contact/emergency numbers will be displayed within the laboratory.
- First aid treatment facility should be also available.

6.3.3.2.Physical Hazards

i) Ergonomic hazards

Laboratory workers are at risk for repetitive motion injuries during routine laboratory procedures such as pipetting, working at microscopes, operating and keyboarding at computer and working on BSC workstations. Standing and working in awkward positions in front of laboratory hoods/biological safety cabinets can also present ergonomic problems.

Ergonomic Hazards Mitigation Measures

- Training of workers in lifting and materials handling techniques during operation, including the placement of weight limits above which mechanical assists or two-person lifts are necessary,
- Planning work site layout to minimize the need for manual transfer of heavy loads,
- Selecting tools and designing workstations that reduce force requirements and holding times, and which promote improved postures, including, where applicable, user adjustable work stations,
- Implementing administrative controls into work processes, such as job rotations and rest or stretch breaks.

ii) Sharp object hazard

Poor collection, handling and transportation of medical waste such as needle, sticks, strains, and sprains may cause physical hazards like cutting, burning eye and back injuries during Several injuries such as hand cut due to handling broken glass occurred due to exposure to lab wastes inside and outside the lab (Bokhoree et al., 2014). During transporting/handling of wastes, the laboratory and ancillary staff as well as the sanitary laborer can be injured if the waste has not been packed safely. In that respect, sharps are considered as one of the most dangerous categories of waste. Many injuries occur because syringe needles or other sharps have not been collected in safety boxes or because these have been overfilled.

Sharp object Mitigation Measures

- Injuries should always be reported to supervisors and victims should get medical attention as soon as possible. Collect broken needles in secured and safe area and dispose all based on WHO standard
- Sharps waste by disposing of it in a sealable container; self-locking and sealable sharps containers are made of plastic so that the sharps cannot easily penetrate through the sides. Such units are designed so that the whole container can be disposed of with other bio hazardous waste, with the support of the government
- Hepatitis B Vaccine should be given for all workers work in laboratory.

iii) Electrical hazards

All equipment needs 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.

Risk related to Electricity Mitigation Measures

- It is essential that all electrical installations and equipment are inspected and tested regularly, including earthing/grounding systems. Circuit-breakers and earth-fault-interrupters should be installed in appropriate laboratory electrical circuits.
- All laboratory electrical equipment would be earthed/grounded, preferably through three-prong plugs.
- All laboratory electrical equipment and wiring would conform to national electrical safety standards and codes.
- Disconnect equipment attached to high-voltage or high-amperage power sources from the source or provide a lockout device on the breaker box to prevent circuit activation before maintenance is performed.
- Because electrical devices can generate sparks, do not use them near flammable or volatile gases or liquids.
- Never place flammable liquids in a household refrigerator. The spark generated by the door-activated light switch can ignite fumes trapped in the unit, causing an explosion and fire.
- Specialized refrigerators would be used when storing chemicals that have explosion potential.

iv) Noise

The effect of excessive noise is insidious over time. Some types of laboratory equipment and stand by generators can produce noise exposure to workers. When it comes to the duration, the impact would be long lasting though insidious. The spatial extent is local affecting onsite lab workers, facilities, patients, and neighboring communities. The likelihood of the impact occurring, and its intensity is low given that the design is up to the standard. However, sensitivity on the receptors is medium; hence the impact significance is moderate.

Impact significance

		Sensitivity of receptor			
		Very low	Low	Medium	High
		1	2	3	4
Intensity of impact	Very low 1	1 Negligible	2 Minor	3 Minor	4 Minor

Low 2		2 Minor	4 Minor	6 Moderate	8 Moderate
Medium 3		3 Minor	6 Moderate	9 Moderate	12 Major
High	4	4 Minor	8 Moderate	12 Major	16 Major

Mitigation Measures for noise impact

- Enclosures or barriers around noisy equipment or between noisy areas and other work areas.
- 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.
- Inform the neighboring communities including those within the hospital of any unusual activities with extraordinary noise levels which includes timing, expected duration and any safety precautions.
- Purchase policy should take equipment noise into consideration; and
- Provide relevant safety gear including ear corks.

6.3.3.3.Biological Hazards

i) Risk of Infection

Surveillance of laboratory acquired infection (LAI) is, therefore, an efficient marker to evaluate the effectiveness of biosafety and to optimize the risk assessment in laboratories (Wurtz et al., 2016). Operation of Vaccine lab involves handling of infectious organisms, chemicals, pharmaceuticals products, etc. As Food and Drug laboratory is expected to perform testing of vaccine, food, pharmaceuticals, and medical equipment's, during specimens' collection, handling, transportation and storage, there will be a risk of exposure for the samples/specimen. If the specimen has a highly infectious agents, it may cause severe human disease, present a serious hazard to workers, and may present a risk of spreading to the community.

Risk of Infection Mitigation Measures

- Laboratory personnel working in the vaccine lab should receive specific training in handling chemicals and potentially lethal agents and would be supervised by competent staff in handling infectious agents and associated procedures,
- All procedures involving the manipulation of infectious materials should be conducted within a BSC, or other physical containment devices,
- Persons would wash- their hands after working with potentially hazardous materials and before leaving the laboratory,
- Spills involving infectious materials would be contained, decontaminated, and cleaned up by staff properly trained and equipped to work with infectious material.
- Equipment would be decontaminated before repair, maintenance, or removal from the laboratory,
- Workers in the laboratory should wear protective laboratory clothing with a solid-front, such as tie-back or wrap-around gowns, scrub suits, or coveralls. Protective clothing will not be worn outside of the laboratory,
- Reusable clothing should be decontaminated before being laundered. Clothing is changed when contaminated,
- Potentially infectious materials should be placed in a durable, leak proof container during collection, handling, processing, storage, or transport within a facility,
- Gloves should be worn to protect hands from exposure to hazardous materials. Gloves should not be worn outside the laboratory. Dispose of used gloves with another contaminated laboratory waste. Hand washing protocols would be rigorously followed,
- Blood should be collected from patients by trained staff,
- For phlebotomies, conventional needle and syringe systems should be replaced by single-use safety vacuum devices that allow the collection of blood directly into stoppered transport and/or culture tubes, automatically disabling the needle after use.

ii) Impact of escaping of Infectious Agents from Vaccine Laboratory

In Vaccine laboratory Risk Group 2 organisms, which are characterized by having moderate individual risk and low community risk, would be handled. Risk Group 2 pathogens are generally pathogens that can cause human or animal disease but are unlikely to be a serious

hazard to laboratory workers, the community, livestock or the environment. Laboratory exposures may cause serious infection, but effective treatment and preventive measures are available and the risk of spread of infection is limited.

The Vaccine laboratory facility designated as basic, hence it is applicable for primary health services, diagnostic services and research. Laboratory practices that need to be in this facility are good microbiological techniques (GMT), protective clothing and biohazard signs. Open bench and biosafety cabinet (BSC) are required for potential aerosols as safety requirement.

In the Vaccine laboratory there would not be highly infectious agents in storage, diagnosis process or culture. So, there would not be a possibility of infectious agents to escape Vaccine laboratory basic laboratory. The safety cabinet is HEPA filter fitted, thus it is supposed that it will filter microbes before leaving the laboratory.

If a system failure has happened for different reasons including fire outbreak, vandalism etc., disease causing microbes could leave the Vaccine laboratory and possibly cause human health impacts. The transmission pathway could be in five ways. These are direct transmission, vehicle-borne transmission, vector-borne transmission, airborne transmission, and water-borne transmission.

Direct transmission: would first require a worker to be exposed to an infectious agent. The likelihood of a worker inhaling or otherwise becoming exposed (for example, through cuts in the skin or ingestion) to an infectious agent would be extremely remote. While it would be very unlikely that a worker would be exposed, if exposed with a sufficient dose, it would be possible for them to be carriers for those agents and through direct transmission expose others. This potential is further reduced through the intervention of effective vaccines or therapeutic measures (CDC, 1999).

Vector-borne Transmission: Vector-borne transmission can include mechanical or biological transmission of infectious agents. Mechanical transmission includes carriage by crawling or flying insects through soiling of feet or proboscis or by passage of organisms through its gastrointestinal tract, it does not require multiplication or development of the organism. Biological transmission includes the propagation (multiplication), cyclic development, or a combination of these. The facility would be designed to severely limit the potential for possible vector-borne transmission through insects and rodents.

Vehicle-borne Transmission: The primary concern for vehicle-borne transmission would be by the workers' clothing or skin and hair, as all other materials leaving the Vaccine laboratory would go through sterilization by autoclave or chemical disinfection. The guidelines established by the CDC and NIH, which would be followed within the proposed Vaccine laboratory, are designed to reduce this potential method of transmission. This would substantially reduce any potential for a worker to unknowingly transport infectious microbes from the facility.

Water-borne Transmission: Potable water would not be affected by the implementation of the proposed action. Facility design features such as anti-back flow need to be fitted to prevent microbes within the facility from migrating back through the water supply piping to the public. Water exiting through the sink drains should be diverted to a retention tank where it would be disinfected before being sent to the sewer system and the other is airborne transmission.

Airborne transmission: Biological hazards can enter the body via aerosols generated from common lab practices. Common aerosol generators in the lab include pipetting, centrifuging, grinding, blending, shaking, mixing, sonicating, opening containers of infectious materials, and inoculating animals intranasally. Inhalation of toxic or pathogenic agents produces poisoning by absorption through the mucous membranes of the mouth, throat, and lungs and damages these tissues seriously by local action. Inhaled substances pass into the capillaries of the lungs and are carried into the circulatory system, where absorption is extremely rapid. Because of the large surface area of the lungs in humans they are the main site for absorption of many toxic or pathogenic agents

The agents that may cause human disease, present a hazard to workers, and may present lower risk of spreading to the community. Duration of the impact would be short-term. The intensity of the impact would be low if working with proper GMT and safety cabinet. Sensitivity of the receptors is medium, giving moderate impact significance.

Impact Significance

		Sensitivity of receptor			
		Very low 1	Low 2	Medium 3	High 4
sit y of im	Very low 1	1	2	3	4

		Negligible	Minor	Minor	Minor
	Low 2	2 Minor	4 Minor	6 Moderate	8 Moderate
	Medium 3	3 Minor	6 Moderate	9 Moderate	12 Major
	High 4	4 Minor	8 Moderate	12 Major	16Major

Mitigation strategies for risk of escaping of infectious agents

The following mitigation strategies would be implemented to prevent infectious agents from escaping

- Laboratory personnel should receive specific training in handling pathogenic microbes and would be supervised by competent staff in handling infectious agents and associated procedures.
- Laboratory workers should be trained in equipment operating and handling techniques during operation,
- Equipment should be periodically maintained and calibrated according to manufacture recommendation
- HEPA filters in the BSCs should be tested at least annually and replaced as necessary.
- Effective vaccines or therapeutic measures should be available for all risk groups.
- The use of pest control programs would limit the potential for transmission of infectious agents from animals to humans.
- Trainings should be provided on sample and waste handling, transportation, and storage.
- All material should be sterilized by autoclave or chemical disinfection
- Ensure that the facility would be designed to severely limit the potential for possible vector-borne transmission through insects and rodents.
- Ensure that water exiting through the sink drains would be diverted to a retention tank where it should be disinfected before being sent to the sewer system.
- All agents should be contained within the laboratory and biosecurity system would be in place.

iii) Impact of Handling of Vaccine Materials and Agents

Improper collection, transport, and handling of specimens/vaccine agents in the laboratory carry a risk of infection to the personnel involved. It may cause severe human disease, present a serious hazard to workers, and may present a risk of spreading to the community.

Duration of the impact associated with poor handling of infectious materials managed by the Vaccine Lab would be short-term. The intensity of the impact would be low as long as the specimen management is as per WHO & WBG EHS Guideline and if the workers use PPE during specimen handling. Sensitivity on the receptors will also be low as long as immunization program is practiced. Thus, the impact significance would be minor.

Impact Significance

		Sensitivity of receptor			
		Very low	Low	Medium	High
		1	2	3	4
Intensity of impact	Very low 1	1 Negligible	2 Minor	3 Minor	4 Minor
	Low 2	2 Minor	4 Minor	6 Moderate	8 Moderate
	Medium 3	3 Minor	6 Moderate	9 Moderate	12 Major
	High 4	4 Minor	8 Moderate	12 Major	16 Major

Mitigation measures for impacts associated with handling of infectious materials and specimens

- Specimen containers should be robust and should not leak when the cap or stopper is correctly applied.
- No material should remain on the outside of the container. Containers should be correctly labelled to facilitate identification.
- Specimen request or specification forms should not be wrapped around the containers but placed in separate, preferably waterproof envelopes.
- 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.

- Laboratories that receive large numbers of specimens should designate a particular room or area for this purpose.
- Personnel who receive and unpack specimens should be aware of the potential health hazards involved, and should be trained to adopt standard precautions, particularly when dealing with broken or leaking containers.
- Primary specimen containers should be opened in a biological safety cabinet.
- Disinfectants should be available.

Mitigation measure of pipettes and pipetting aids

- A pipetting aid must always be used. Pipetting by mouth must be prohibited.
- All pipettes should have cotton plugs to reduce contamination of pipetting devices.
- Air should never be blown through liquid containing infectious agents.
- Infectious materials should not be mixed by alternate suction and expulsion through a pipette.
- Liquids should not be forcibly expelled from pipettes.
- Mark-to-mark pipettes are preferable to other types as they do not require expulsion of the last drop.
- Contaminated pipettes should be completely submerged in a suitable disinfectant contained in an unbreakable container. They should be left in the disinfectant for the appropriate length of time before disposal.
- A discard container for pipettes should be placed within the biological safety cabinet, not outside it.
- Syringes fitted with hypodermic needles must not be used for pipetting.
- To avoid dispersion of infectious material dropped from a pipette, an absorbent material should be placed on the working surface; this should be disposed of as infectious waste after use.

Avoiding the dispersal of infectious materials

- To avoid the premature shedding of their loads, microbiological transfer loops should have a diameter of 2–3 mm and be completely closed. The shanks should be not more than 6 cm in length to minimize vibration.
- The risk of spatter of infectious material in an open Bunsen burner flame should be avoided by using an enclosed electric micro-incinerator to sterilize transfer loops. Disposable transfer loops, which do not need to be re-sterilized, are preferable.

- Care should be taken when drying sputum samples, to avoid creating aerosols.
- Discarded specimens and cultures for autoclaving and/or disposal should be placed in leakproof containers, e.g. laboratory discard bags. Tops should be secured (with autoclave tape) prior to disposal into waste containers.
- Working areas must be decontaminated with a suitable disinfectant at the end of each work period.

Use of biological safety cabinets

- The use and limitations of biological safety cabinets should be explained to all potential users, with reference to national standards and relevant literature. Written protocols or safety or operations manuals should be issued to staff. In particular, it must be made clear that the cabinet will not protect the operator from spillage, breakage or poor technique.
- The cabinet must not be used unless it is working properly.
- The glass viewing panel must not be opened when the cabinet is in use.
- Apparatus and materials in the cabinet must be kept to a minimum. Air circulation at the rear plenum must not be blocked.
- Bunsen burners must not be used in the cabinet. The heat produced will distort the airflow and may damage the filters. An electric micro-incinerator is permissible but sterile disposable transfer loops are better.
- All work must be carried out in the middle or rear part of the working surface and be visible through the viewing panel.
- Traffic behind the operator should be minimized.
- The operator should not disturb the airflow by repeated removal and reintroduction of his or her arms.
- Air grills must not be blocked with notes, pipettes or other materials, as this will disrupt the airflow causing potential contamination of the material and exposure of the operator.
- The surface of the biological safety cabinet should be wiped using an appropriate disinfectant after work is completed and at the end of the day.
- The cabinet fan should be run for at least 5 min before beginning work and after completion of work in the cabinet.
- Paperwork should never be placed inside biological safety cabinets.

Avoiding ingestion of infectious materials and contact with skin and eyes

- Disposable gloves should be worn. Laboratory workers should avoid touching their mouth, eyes and face.
- Food and drink must not be consumed or stored in the laboratory.
- Nothing should be placed in the mouth – pens, pencils, chewing gum – in the laboratory.
- Cosmetics should not be applied in the laboratory.
- The face, eyes and mouth should be shielded or otherwise protected during any operation that may result in the splashing of potentially infectious materials.

Avoiding injection of infectious materials

- Accidental inoculation resulting from injury with broken or chipped glassware can be avoided through careful practices and procedures. Glassware should be replaced with plastic ware whenever possible.
- Needle-stick injuries can be reduced by: (a) minimizing the use of syringes and needles (simple devices are available for opening septum-stoppered bottles so that pipettes can be used instead of syringes and needles; or (b) using engineered sharp safety devices when syringes and needles are necessary.
- Needles should never be recapped. Disposable articles should be discarded into puncture-proof/puncture-resistant containers fitted with covers.
- Plastic Pasteur pipettes should replace those made of glass.

Separation of serum

- Only properly trained staff should be employed for this work.
- Gloves, eye, and mucous membrane protection should be worn.
- Splashes and aerosols can only be avoided or minimized by good laboratory technique. Blood and serum should be pipetted carefully, not poured. Pipetting by mouth must be forbidden.
- After use, pipettes should be completely submerged in suitable disinfectant. They should remain in the disinfectant for the appropriate time before disposal or washing and sterilization for reuse.
- Discarded specimen tubes containing blood clots, etc. should be placed in suitable leakproof containers for autoclaving and/or incineration.
- Suitable disinfectants should be available for clean-up of splashes and spillages

Use of centrifuges

- Satisfactory mechanical performance is a prerequisite of microbiological safety in the use of laboratory centrifuges.
- Centrifuges should be operated according to the manufacturer's instructions.
- Centrifuges should be placed at such a level that workers can see into the bowl to place trunnions and buckets correctly.
- Centrifuge tubes and specimen containers for use in the centrifuge should be made of thick-walled glass or preferably of plastic and should be inspected for defects before use.
- Tubes and specimen containers should always be securely capped (screw-capped if possible) for centrifugation.
- The buckets must be loaded, equilibrated, sealed and opened in a biological safety cabinet.
- Buckets and trunnions should be paired by weight and, with tubes in place, correctly balanced.
- The amount of space that should be left between the level of the fluid and the rim of the centrifuge tube should be given in manufacturer's instructions.
- Distilled water or alcohol (propanol, 70%) should be used for balancing empty buckets. Saline or hypochlorite solutions should not be used as they corrode metals.
- When using angle-head centrifuge rotors, care must be taken to ensure that the tube is not overloaded as it might leak.
- The interior of the centrifuge bowl should be inspected daily for staining or soiling at the level of the rotor. If staining or soiling are evident then the centrifugation protocols should be re-evaluated.
- Centrifuge rotors and buckets should be inspected daily for signs of corrosion and for hair-line cracks.
- Buckets, rotors and centrifuge bowls should be decontaminated after each use.
- After use, buckets should be stored in an inverted position to drain the balancing fluid.
- Infectious airborne particles may be ejected when centrifuges are used. These particles travel at speeds too high to be retained by the cabinet airflow if the centrifuge is placed in a traditional open-fronted Class I or Class II biological safety cabinet. Enclosing centrifuges in Class III biosafety cabinets prevents emitted aerosols from dispersing

widely. However, good centrifuge technique and securely capped tubes offer adequate protection against infectious aerosols and dispersed particles.

Use of homogenizers, shakers, blenders and sonicators

- Domestic (kitchen) homogenizers should not be used in laboratories as they may leak or release aerosols. Laboratory blenders and stomachers are safer.
- Caps and cups or bottles should be in good condition and free from flaws or distortion. Caps should be well-fitting and gaskets should be in good condition.
- Pressure builds up in the vessel during the operation of homogenizers, shakers and sonicators. Aerosols containing infectious materials may escape from between the cap and the vessel. Plastic, in particular, poly-tetra-fluoro-ethylene (PTFE) vessels are recommended because glass may break, releasing infectious material and possibly wounding the operator.
- When in use, homogenizers, shakers and sonicators should be covered by a strong transparent plastic casing. This should be disinfected after use. Where possible, these machines should be operated, under their plastic covers, in a biological safety cabinet.
- At the end of the operation the containers should be opened in a biological safety cabinet.
- Hearing protection should be provided for people using sonicators.

Use of tissue grinders

- Glass grinders should be held in absorbent material in a gloved hand. Plastic (PTFE) grinders are safer.
- Tissue grinders should be operated and opened in a biological safety cabinet.

Care and use of refrigerators and freezers

- Refrigerators, deep-freezers, and solid carbon dioxide (dry-ice) chests should be defrosted and cleaned periodically, and any ampoules, tubes, etc. that have broken during storage removed. Face protection and heavy-duty rubber gloves should be worn during cleaning. After cleaning, the inner surfaces of the cabinet should be disinfected.
- All containers stored in refrigerators and freezers should be clearly labelled with the scientific name of the contents, the date stored and the name of the individual who stored them. Unlabeled and obsolete materials should be autoclaved and discarded.
- An inventory must be maintained of the freezer's contents.

- Flammable solutions must not be stored in a refrigerator unless it is explosion proof. Notices to this effect should be placed on refrigerator doors.

Opening of ampoules containing lyophilized infectious materials

Care should be taken when ampoules of freeze-dried materials are opened, as the contents may be under reduced pressure and the sudden inrush of air may disperse some of the materials into the atmosphere. Ampoules should always be opened in a biological safety cabinet. The following procedures are recommended for opening ampoules.

- First decontaminate the outer surface of the ampoule.
- Make a file mark on the tube near to the middle of the cotton or cellulose plug, if present.
- Hold the ampoule in alcohol-soaked cotton to protect hands before breaking it at a file scratch.
- Remove the top gently and treat as contaminated material.
- If the plug is still above the contents of the ampoule, remove it with sterile forceps.
- Add liquid for re-suspension slowly to the ampoule to avoid frothing.

Storage of ampoules containing infectious materials

Ampoules containing infectious materials should never be immersed in liquid nitrogen because cracked or imperfectly sealed ampoules may break or explode on removal. If very low temperatures are required, ampoules should be stored only in the gaseous phase above the liquid nitrogen. Otherwise, infectious materials should be stored in mechanical deep-freeze cabinets or on dry ice. Laboratory workers should wear eye and hand protection when removing ampoules from cold storage.

The outer surfaces of ampoules stored in these ways should be disinfected when the ampoules are removed from storage.

Collection, labelling and transport of specimens

- Standard precautions should always be followed; gloves should be worn for all procedures. Blood should be collected from patients and animals by trained staff. For phlebotomies, conventional needle and syringe systems should be replaced by single-use safety vacuum devices that allow the collection of blood directly into stoppered transport and/or culture tubes, automatically disabling the needle after use.

- The tubes should be placed in adequate containers for transport to the laboratory and within the laboratory facility. Request forms should be placed in separate waterproof bags or envelopes.
- Reception staff should not open these bags.

Opening specimen tubes and sampling contents

- Specimen tubes should be opened in a biological safety cabinet.
- Gloves must be worn. Eye and mucous membrane protection is also recommended (goggles or face shields).
- Protective clothing should be supplemented with a plastic apron.
- The stopper should be grasped through a piece of paper or gauze to prevent splashing.

Glass and "sharps"

- Plastics should replace glass wherever possible. Only laboratory grade (borosilicate) glass should be used, and any article that is chipped or cracked should be discarded.
- Hypodermic needles must not be used as pipettes.

Films and smears for microscopy

Fixing and staining of blood, sputum and other samples for microscopy do not necessarily kill all organisms or viruses on the smears. These items should be handledwith forceps, stored appropriately, and decontaminated and/or autoclaved beforedisposal.

Automated equipment (sonicators, vortex mixers)

- Equipment should be of the closed type to avoid dispersion of droplets and aerosols.
- Effluents should be collected in closed vessels for further autoclaving and/or disposal.
- Equipment should be disinfected at the end of each session, following manufacturers' instructions.

Tissues

- Formalin fixatives should be used.
- Frozen sectioning should be avoided. When necessary, the cryostat should be shielded and the operator should wear a safety face shield. For decontamination, the temperature of the instrument should be raised to at least 20 °C.

Decontamination

Hypochlorites and high-level disinfectants are recommended for decontamination.

Freshly prepared hypochlorite solutions should contain available chlorine at 1 g/l for general use and 5 g/l for blood spillages. Glutaraldehyde may be used for decontaminating surfaces.

Precautions with materials that may contain prions

Prions (also referred to as "slow viruses") are associated with the transmissible spongiform encephalopathies (TSEs), notably Creutzfeldt-Jakob disease (CJD), Gerstmann-Sträussler-Scheinker syndrome, fatal familial insomnia and kuru in humans.

Although CJD has been transmitted to humans, there appear to be no proven cases of laboratory-associated infections with any of these agents. Nevertheless, it is prudent to observe certain precautions in the handling of material from infected or potentially infected humans and animals.

The selection of a biosafety level for work with materials associated with TSEs will depend on the nature of the agent and the samples to be studied and should be undertaken in consultation with national authorities. It is unlikely to examine prions in this lab, but if in case examined, the following precautions need to be taken care:

- Prions are not killed by the normal processes of laboratory disinfection and sterilization.

  As complete inactivation of prions is difficult to achieve, it is important to stress the use of disposable instruments whenever possible, and to use a disposable protective covering for the work surface of the biological safety cabinet.
- The main precaution to be taken is to avoid ingestion of contaminated materials or puncture of the laboratory worker's skin.
- The use of dedicated equipment, i.e. equipment not shared with other laboratories, is highly recommended.
- Disposable laboratory protective clothing (gowns and aprons) and gloves must be worn (steel mesh gloves between rubber gloves for pathologists).
- Use of disposable plastic ware, which can be treated and discarded as dry waste, is highly recommended.
- Tissue processors should not be used because of the problems of disinfection. Jars and beakers (plastic) should be used instead.
- All manipulations must be conducted in biological safety cabinets.

- Great care should be exercised to avoid aerosol production, ingestion, and cuts and punctures of the skin.
- Formalin-fixed tissues should be regarded as still infectious, even after prolonged exposure to formalin.
- Histological samples containing prions are substantially inactivated after exposure to 96% formic acid for 1 h (Brown et al., 1990).
- Bench waste, including disposable gloves, gowns and aprons, should be autoclaved using a porous load steam sterilizer at 134–137 °C for a single cycle of 18 min, or six successive cycles of 3 min each, followed by incineration.
- Non-disposable instruments, including steel mesh gloves, must be collected for decontamination.
- Infectious liquid waste contaminated with prions should be treated with sodium hypochlorite containing available chlorine at 20 g/l (2%) (Final concentration) for 1 h.
- Paraformaldehyde vaporization procedures do not diminish prion titres and prions are resistant to ultraviolet irradiation. However, the cabinets must continue to be decontaminated by standard methods (i.e. formaldehyde gas) to inactivate other agents that may be present.
- Prion-contaminated biological safety cabinets and other surfaces can be decontaminated with sodium hypochlorite containing available chlorine at 20 g/l (2%) for 1 h.
- High-efficiency particulate air (HEPA) filters should be incinerated at a minimum temperature of 1000 °C after removal.

Recommended additional steps prior to incineration include:

- Instruments should be soaked in sodium hypochlorite containing available chlorine at 20 g/l (2%) for 1 h and then rinsed well in water before autoclaving. Instruments that cannot be autoclaved can be cleaned by repeated wetting with sodium hypochlorite containing available chlorine at 20 g/l (2%) over a 1-h period. Appropriate washing to remove residual sodium hypochlorite is required.

iv) Misuse or abuse or theft of laboratory equipment/supplies and or infectious agent

Though this is not the type of laboratory that can attract attention, meaningfully bioterrorism and recent technological advances in gene synthesis and gene editing have brought the dual use nature of biological research into public focus. The potential for misuse is especially

apparent with respect to research on human pathogens. Awareness of misuse or abuse of biological agents is needed in virtually all research fields involving use of biological material and development and application of new technologies.

In vaccine labs, there would be agents that can be misused and/or stolen. 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.

When it comes to the duration, the impact would be long- lasting. The spatial extent may go wider affecting the community. Given the type of microbes in a vaccine lab, the impact would possibly be reversible. The likelihood of the impact occurring is low given that the staffs are trained. However, sensitivity on the receptors side is medium; hence the impact significance is moderate.

Impact significance

		Sensitivity of receptor			
		Very low 1	Low 2	Medium 3	High 4
Intensity of impact	Very low 1	1 Negligible	2 Minor	3 Minor	4 Minor
	Low 2	2 Minor	4 Minor	6 Moderate	8 Moderate
	Medium 3	3 Minor	6 Moderate	9 Moderate	12 Major
	High 4	4 Minor	8 Moderate	12 Major	16 Major

Mitigation measures for Misuse or abuse or theft of laboratory equipment/supplies and or infectious agent

- Strict Biosecurity measures should be implemented to limit access to facilities, research materials and information.
- Digital inventory system needs to be there for both the microorganisms and equipment.
- Measures should be developed to protect against the insider and outsider threat and any natural or man-made events that could cause a release.

- Establish system for physical security, personnel security, material control & accountability, and information security.
- All staff needs to have training in laboratory security and biosecurity.

Sensitive areas should always be locked, and non-authorized ad unauthorized entry should be avoided.

v) The Laboratory Release Accident Scenario

The infectious microorganisms could escape from the laboratory facility, but the microbes in this lab are those having medication. So, they cannot bring about big public health threat. Catastrophic events such as earthquake, fire, explosions, and airplane crashes, normally considered as initiating events for increased risk on microbiological material releases.

The probability of catastrophic events (due to earthquake) is very low. The low probability of an earthquake capable of rupturing the facility containment, coupled with an additionally low probability of such an event occurring during a daytime activity where microorganism containment would be vulnerable, also makes it an unlikely event.

The probability that such an accident would happen is very low. Duration of impact is long lasting. Extent of impact is local and impact is medium. Sensitivity of receptors is medium. Thus, impact significance is minor.

Impact significance

		Sensitivity of receptor			
		Very low	Low	Medium	High
		1	2	3	4
Intensity of impact	Very low 1	1 Negligible	2 Minor	3 Minor	4 Minor
	Low 2	2 Minor	4 Minor	6 Moderate	8 Moderate
	Medium 3	3 Minor	6 Moderate	9 Moderate	12 Major
	High 4	4 Minor	8 Moderate	12 Major	16 Major

Mitigation strategies for the laboratory release accident scenario

- In an emergency response mode, the responder should enter only after ascertaining the risk and wearing appropriate PPE;
- Facility would have an emergency preparedness and response plan; and,

- The workers should have the appropriate prophylaxis available or immunization prior to working in the laboratory and should not become symptomatic.

6.3.4. Community Health and Safety Impacts

i) Communicable Diseases

The newly influx of people due to the operation of this project may bring health problem to the people of the host community including COVID-19 and HIV/AIDS which transmits during a physical contact and blood insertion respectivelly. This means an increase in labor influx in the project site: may induce sex work and potential sexual relations between migrant workers and women and girls in the community. This may lead to an increase in the risk of acquiring sexually transmitted diseases, such as HIV/AIDS, etc. In turn, workers, individually and collectively, will be susceptible to the corona-virus as the construction works normally require teamwork. Increase in risk of sexually transmitted diseases, such as HIV/AIDS etc. due to labor influx induced sex work and potential sexual relations between migrant workers and women and girls in the community.

In the vaccine lab there would be highly infectious agents in storage, or culture. So, that there would be a possibility to escape infectious agents vaccine lab Containment. Potential means for infectious agents to leave the vaccine lab containment and possibly cause human health impacts to the surrounding community and workers.

The probability that such would happen is very low. Duration of impact is long lasting. Extent of impact is local, and impact is medium. Sensitivity of receptors is medium. Thus, impact significance is minor.

Impact significance

		Sensitivity of receptor			
		Very low	Low	Medium	High
		1	2	3	4
Intensity of impact	Very low 1	1 Negligible	2 Minor	3 Minor	4 Minor
	Low 2	2 Minor	4 Minor	6 Moderate	8 Moderate
	Medium 3	3 Minor	6 Moderate	9 Moderate	12 Major
	High 4	4 Minor	8 Moderate	12 Major	16 Major

Comunicable Disease Mitigation Measures

- Laboratory personnel working in vaccine labshould receive specific training in handling pathogenic and potentially lethal agents and should be supervised by competent staff in handling infectious agents and associated procedures,
- Laboratory workers would be trained in equipment operating and handling techniques during operation,
- Effective vaccines or therapeutic measures would be available for all risk groups,
- The use of pest control programs would limit the potential for transmission of infectious agents from animals to humans,
- Trainings should be provided on sample and waste handling, transportation, and storage, and disposal,
- All material would be sterilized by autoclave or chemical disinfection
- Ensure that the facility should be designed to severely limit the potential for possible vector-borne transmission through insects and rodents,
- Ensure that water exiting through the sink drains would be diverted to a retention tank where it would be disinfected before being sent to the sewer system.
- All agents would be contained within the laboratory and biosecurity system would be in place
- Promote the use of condom, and implementation of HIV/AIDS education program; and get vaccine for Covid 19,
- BSCs HEPA filters would be tested annually and replaced as necessary,
- Ensure that the facility would be designed to severely limit the potential for possible vector-borne transmission through insects and rodents.

ii) Traffic and Community Safety Impacts

The operations of vaccine lab will create additional job opportunity for 45 citizens. There will be increase traffic flow resulting from the transport for staffs and patients and introduction of new cars from the employees. This may lead to increased traffic jams and hazards in the area especially if the roads in the region are not upgraded to cater for this demand. The area will also experience an increase in traffic albeit intermittent, and this will increase the risk of traffic hazards since the probability of occurrence of the hazards will be increased by having

more cars on the roads.Additionally, the vaccine lab project may put the employees at risk for the spread of diseases including COVID-19, and alike.

The probability that such would happen is very low. Duration of impact is long lasting. Extent of impact is local, and impact is medium. Sensitivity of receptors is medium. Thus, impact significance is minor.

Impact significance

		Sensitivity of receptor			
		Very low 1	Low 2	Medium 3	High 4
Intensity of impact	Very low 1	1 Negligible	2 Minor	3 Minor	4 Minor
	Low 2	2 Minor	4 Minor	6 Moderate	8 Moderate
	Medium 3	3 Minor	6 Moderate	9 Moderate	12 Major
	High 4	4 Minor	8 Moderate	12 Major	16 Major

Traffic and Public Safety Impacts Mitigation Measures

- Placing visible and readable signs to the main gate where there are risks and arrange designated car parking,
- Apply "Three E" philosophy and to be transparent and proactive about all traffic initiatives.
  - **Enforcement** – including duties performed by Addis Ababa Police (Traffic Management Bureau) and Woreda by-law enforcement staff.
  - **Education** – including Speed Management Program and Safety Driven education campaign.
  - **Engineering** – including issues related to road design on existing roads and planning for future projects.

6.3.5. Social Impact

i) Increase Burden on community Service

The arrival of newly employed workers would rise demand and competition for local social and health services, as well as for goods and services, which can lead to price hikes and crowding out of local consumer. The implementation of this project will add the pressure in

waste management of the exsting people, electricity, access of clean water, traffick management, fire disasters.

Since laboratory services will continue to be provided during the construction period, patients seeking to give or deliver samples to the present sample collection rooms found next to the site will be urged to cross through the construction area. Frequent changes of designated safe pathways across the construction site to the sample collection area will entail moving patients. This may cause inconveniences and temporary disruption in delivery of sample collection services to patients.

The probability that such would happen is very low. Duration of impact is long lasting. Extent of impact is local, and impact is medium. Sensitivity of receptors is medium. Thus, impact significance is minor.

Impact significance

		Sensitivity of receptor			
		Very low	Low	Medium	High
		1	2	3	4
Intensity of impact	Very low 1	1 Negligible	2 Minor	3 Minor	4 Minor
	Low 2	2 Minor	4 Minor	6 Moderate	8 Moderate
	Medium 3	3 Minor	6 Moderate	9 Moderate	12 Major
	High 4	4 Minor	8 Moderate	12 Major	16 Major

Community Service Burden Mitigation Measures

1. The project needs to provide its own transportation for staffs,
2. In collaboration with concerned sectors, the vaccine lab project should ensure the access of additional electric transformer whereby they can keep the existing power utilized by the community,
3. Drill a borehole within the project site for the water source.

Work with the community and city administration to make the access road asphalt smooth during entrance and leaving of the campus,

ii) Risk of Social Conflict and Crime

Workers who have different political and religious inters may be employed by this project, which will in turn lead to distrust, suspicion and lack of tolerance among workers. Such ethnocentric attitude to be emanated from some workers may disseminate to others and disturb the function of the institution.

The probability that such would happen is very low. Duration of impact is long lasting. Extent of impact is local and impact is medium. Sensitivity of receptors is medium. Thus, impact significance is minor.

Impact significance

		Sensitivity of receptor			
		Very low	Low	Medium	High
		1	2	3	4
Intensity of impact	Very low 1	1 Negligible	2 Minor	3 Minor	4 Minor
	Low 2	2 Minor	4 Minor	6 Moderate	8 Moderate
	Medium 3	3 Minor	6 Moderate	9 Moderate	12 Major
	High 4	4 Minor	8 Moderate	12 Major	16 Major

Risk of Social Conflict and Crime Mitigation Measures

- Transparent local community engagement and participation should begin during initial project decision-making and continue routinely throughout the life of the project,
- Awareness-raising among local community, contract workers and staffs about cultures and norms of the local community,
- Provision of cultural sensitization training for all staffs regarding engagement with local community,
- Provide awareness creation program about tolerance of diversity and,
- Develop code of conduct for staffs to prevent discrimination and other ethnocentric behaviors

iii) Gender Based Violence Impacts

The professional staffs once they changed their street cloth in the changing room, which is found at the ground floor, they get confined in floor 1 and floor 2, where there are the actual lab works. It is only the sample collector who interacts with members of the public that come

to deliver samples or collect results. On the other side, there may happen GBV cases within the staff itself.

When it comes to the duration, the impact would be long- term (i.e., as long as the lab functions). The spatial extent is local, affecting laboratory workers and members of the public (patients). Given the high-level awareness of GBV by the staff, the likelihood of occurrence and its intensity will be low. Sensitivity on the receptors side is high; hence the impact significance is moderate.

Impact significance

		Sensitivity of receptor			
		Very low	Low	Medium	High
		1	2	3	4
Intensity of impact	Very low 1	1 Negligible	2 Minor	3 Minor	4 Minor
	Low 2	2 Minor	4 Minor	6 Moderate	8 Moderate
	Medium 3	3 Minor	6 Moderate	9 Moderate	12 Major
	High 4	4 Minor	8 Moderate	12 Major	16 Major

Mitigation measures for gender-based violence impacts

- Conducting regular sensitization and awareness-raising workshops to staff on prevention of GBV.
- Establishing and strengthening the gender and women team in the facility to address GBV cases when it occurs.

7. IMPLEMENTATION OF THE ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN

The ESMP will be implemented with an adaptive management approach to respond to changes occurring at different stages of the Project and, as a living document, will be updated to reflect the current status of the Project and site features and management requirements when necessary.

EFDA/MOH is obliged to implement the ESMP with adequate and qualified personnel working under an appropriate organizational structure, in line with Project standards, in line with stakeholder participation and information sharing requirements, and to ensure that contractors/subcontractors adopt management controls.

And this section addresses institutional responsibilities for implementation of activities proposed formanagement of environmental and social risks, environmental monitoring, capacity developmentand training, and Chance Finds and GRM Procedure.

7.1. Institutional Arrangement, Roles and Responsibilities for ESMP Implementation

Institutional responsibility of implementing this ESMP will rest with the Project CoordinationTeam, under Engineering Service Directorate (ESD) at MoH. A key role of the unit would be among others, to review consultants' reports for compliance with the ESMP.

Other roles will be:

- Monitoring implementation of mitigation actions by contractors
- Coordinating and providing training and capacity building where planned
- Periodically report to MoH about implementation of the ESMP

The ESD at the Ministry of Health (MOH) shall serve as the implementing body with the mandate to:

- Prepare plans for effective project development and management.
- Co-ordinate the project programs and actions plan, and the various sub-project safeguard activities;
- Managesprojectconstructioncontractsandsupervisesprojectsights;
- Ensure that the design of the project incorporate provision for addressing environmental impacts, including facilities for infectious and hazardous healthcare waste management

- Develop environment, health and safety standards for contractors; incorporate such requirements in construction contracts, and monitoring compliance to these requirements.

The Project Coordination Team is led by a team leader, and focal persons who have supervisoryroles and are responsible for collecting information about respective components. Supervision ofthe implementation of this ESMP will be under the Public Health Infrastructure component. MOH should ensure that all its personnel to be involved in the implementation of this ESMP are adequately qualified and were appointed based on their qualification and suitability for respective roles.

Oversight to ensure mitigation actions are implemented will rest with the ESD at MOH but health workers at facility level, Project Coordination Unit, In-charge Officials of each facility and Work supervisor will have similar responsibility. MOH shall require contractors to comply with this ESMP and where a contractor has an Environmental and Social Officer, he/she will undertake environmental supervision during construction. It is believed that the project proponent in this case, the ESD, Project Implementation Unit (PIU), the construction supervisor and the Addis Ababa Administration EPA responsible for environmental protection will take the major responsibility in supervising the implementation of the environmental mitigation and monitoring plans.

For mitigation measures related to design change, the engineering consultancy organization assigned to design the proposed development project will be responsible for incorporating the recommended mitigation measures into the design and into the technical specifications of the main project report.

During construction, the contractor will be responsible for implementing environmental and social mitigation measures included in the present ESIA report. The construction supervisor and delegated officers from the ESD and PIU will monitor the proper implementation of mitigating measures at the right time. The Contractor will be fully responsible for ensuring that all the work will be carried out as per the environmental requirements indicated in the design and technical specifications and the present ESIA/ESMP report.

The delegated staffs from the ESD and PIU and the construction supervisor's environmentalist will be jointly responsible for the overall coordination of the environmental and social management activities. They will advise the contractors, construction supervisors, the project management unit of the ESD/PIU and the relevant authorities regarding the implementation of the environmental mitigating measures and monitoring of impacts.

During the operation period, the environmental issues will be monitored jointly by Ethiopian Environmental Protection Agency (EPA) or its counterpart city office, Sub-city, Woreda (such as Woreda 5), and the EFDA. The Management of the Project (Vaccine Laboratory) may also organize a unit for Environment, Health and Safety to enable implementation and monitoring of the mitigation measures during operational phases. In addition, AAWSSA will also involve in wastewater and solid waste disposal.

The EFDA will have a biosafety and security unit to address and comply with regulations and recommendations for biosafety and biosecurity, and as well as the health and safety of the staff, researchers, community, and environment. EFDA will be responsible for overall management of the proposed Vaccine Laboratory building. To maintain regulatory compliance and to protect personnel, the community and the environment from biohazards, EFDA will be responsible for appointing laboratory director, biosafety and biosecurity officer and other technical and support staff required for the vaccine lab building; ensuring appropriate training is provided to personnel conducting research with biohazards or recombinant or synthetic nucleic acid materials; ensuring that research conforms to the provisions of best international practices such as the NIH Guidelines, BMBL, WHO Biosafety Manual and this ESIA; establishing and maintaining a Biosafety Committee ;establishing and maintaining a health surveillance program for personnel; reporting, when required, any significant problems, violations or significant research-related accidents or illnesses to pertinent Ethiopian Public Health and Environmental issues regulatory organs; and facilitating the preparation of guidelines, policies and plan relevant for smooth functioning of the lab.

The vaccine lab building will employee a full-time based and temporary worker, the number of personnel will be determined based on the workload. The staffs to be deployed includes laboratory director, laboratory scientist, laboratory quality Manager, biosafety and biosecurity officer, 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 their roles and responsibilities are described in this ESIA report document.

Table 9: Roles and Responsibilities Regarding the Implementation of the ESMP

EFDA/MOH
EFDA/MOH will be responsible for overall management of the proposed vaccine lab building. To maintain regulatory compliance and to protect personnel, the community and

the environment from biohazards, EFDA will be responsible for:

- ✓ Implementation of ESMP and related management plans and fulfillment of all commitments within the scope of ESCP
- ✓ Sharing the ESMP and management plans with the Contractor, guiding the Contractor in preparing the implementation plans, approving these plans
- ✓ Updating the ESMP when necessary and sharing additional commitments with the Contractor
- ✓ Employment of competent EHS staff and external experts to work under the project
- ✓ Providing EHS trainings to all Project staff
- ✓ Coordination of the actions and assessments if a change due to engineering/design changes, route/location changes, and applicable legislation changes related to environmental and social issues, authority provision changes, any new environmental/social data is introduced; construction/operation strategy changes or stakeholders influence the project.
- ✓ Appointing laboratory director, biosafety and biosecurity officer and other technical and support staff required for the vaccine lab building
- ✓ Ensuring appropriate training is provided to personnel conducting research with biohazards or recombinant or synthetic nucleic acid materials.
- ✓ Establishing and maintaining a *Biosafety Committee*
- ✓ Establishing and maintaining a health surveillance program for personnel.
- ✓ Reporting, when required, any significant problems, violations or significant research-related accidents or illnesses to pertinent Ethiopian Public Health and Environmental issues regulatory organs.
- ✓ Facilitating the preparation of guidelines, policies and plan relevant for smooth functioning of the facilities
- ✓ Finance the construction/procurement of medical wastewater management facility and incinerator; and oversee the proper functionality of the medical waste management facilities

PMU/PIU

- ✓ Evaluating the implementation of ESMP and related management plans and fulfillment of all commitments within the scope of ESCP
- ✓ Participate in the updating the ESMP when necessary

- ✓ Facilitating the employment of competent EHS staff and external experts to work under the project
- ✓ Facilitating the coordination of the actions and assessments if a change due to engineering/design changes, route/location changes, and applicable legislation changes related to environmental and social issues, authority provision changes, any new environmental/social data is introduced; construction/operation strategy changes or stakeholders influence the project.
- ✓ Ensuring the appointment of laboratory director, biosafety and biosecurity officer and other technical and support staff required for the vaccine lab building
- ✓ Facilitating the preparation of guidelines, policies and plan relevant for smooth functioning of the facilities
- ✓ Ensure and notify (to the responsible government officials in MOH and the Bank) any incident or accident related to the Project which has a significant adverse effect on the environment, the affected communities, the public or workers including but not limited to; incidents and accidents encountered during construction works, environmental spills, etc

Biosafety and Biosecurity Committee

The Biosafety Committee will oversee the review, approval and oversight of biohazards in the facilities. Specifically, the committee will be responsible for assessment of facilities in collaboration with the Biosafety Officer, and developing procedures, practices, and training of staff, or taking other steps necessary to assure compliance with WHO standard, *CDC Guidelines, the BMBL,* and other pertinent standards and regulations.

Besides, Biosafety Committee will supervise the infection control and waste management system of EFDA and the committee will be responsible to action for any deviation from the waste management procedure practices or malpractice during waste handling transportation, storage, treatment and disposal.

Environmental and Social Safeguards Specialist

- ✓ Environmental review, monitoring and audits related to ESMP practices, evaluation of results
- ✓ Auditing contractor activities in line with ESMP requirements
- ✓ Ensuring compliance with project standards, making necessary emergency corrections

in case of non-compliance

- ✓ Stopping work in any situation that threatens environment and human health and safety
- ✓ Providing follow-up and analysis of environmental and social accidents
- ✓ Ensuring stakeholder participation, implementing the grievance mechanism, ensuring continuous information transfer through open communication
- ✓ Promptly notify the GMU/PIU of any incident or accident related to the Project which has, or is likely to have, a significant adverse effect on the environment, the affected communities, the public or workers including but not limited to; incidents and accidents encountered during construction works, environmental spills, etc.
- ✓ Provide sufficient detail regarding the incident or accident, findings of the Root Cause Analysis (RCA), indicating immediate measures or corrective actions taken or that are planned to be taken to address it, compensation paid, and any information provided by any contractor and supervision consultant, as appropriate. Ensure the incident report is in line with the World Bank's Environment and Social Incidence Response Toolkit (ESIRT).
- ✓ Subsequently, as per the Bank's request, prepare a report on the incident or accident and propose any measures to prevent its recurrence.

Construction Contractor

- ✓ Fulfillment of all requirements of the ESMP and management plans
- ✓ Implementation of additional commitments determined by ESD/MOH
- ✓ Ensuring compliance with project standards, obtaining all relevant permits and licenses
- ✓ Monitoring construction activities (including subcontractor activities) and taking measures within the scope of the ESMP
- ✓ Development of implementation and monitoring plans / procedures in line with the ESMP structure, implementation after the approval of ESD/MOH
- ✓ Employment of competent EHS staff within the scope of the project
- ✓ Providing the necessary trainings to the workers and sub-contractor staff on environmental and social issues
- ✓ Providing follow-up and analysis of environmental and social accidents
- ✓ Environmental inspections, monitoring and audits related to ESMP practices, reporting to ESD/EFDA
- ✓ Prompt notification of accident and incidents and keeping an incident register at

construction site throughout the Project life.

7.2. Mitigation Measures Implementation Plan

The mitigation measures for anticipated environmental and social risks for the proposed vaccine lab building is outlined in Table 10.

Table 10: Environmental and Social risks mitigation measures and implementation plan

Potential environmental &social impacts	Proposed mitigation measures	Responsible for implementing the mitigation measures	Time Horizon	Indicative Budget for implementation (USD)
Pre-construction phase				
Design fault	Improve and approved design against WBGEHS guideline for facility design,WHO Laboratory safety manual.	Consultants/ MOH/EFDA	Before construction	6,000.00
Construction phase				
Positive impact				
1. Income generation: construction material suppliers and contractors	- The project will promote in country procurement where technically or commercially reasonable and feasible. - Forearthmaterials,procurefromlegitimatesourcestoavoidencouragingenvironmentaldegradation	- Construction contractor	During Construction Phase	Budget included in project cost
2. Employment Opportunities	- Labor will be recruited exclusively from local community, and professionals will be recruited preferentially from such communities, provided that they have the requisite qualification, competence and desired experience - Contractors will be required to pay a “living wage” to all workers.	- Construction contractor - Construction supervisor	During Construction Phase	Budget included in project cost
Negative impact				
Design fault	During design consider the standard requirements indicated in WBG EHS guideline, OSH laboratory safety guidance and	MOH/EFDA/ Contractor	During	

Potential environmental &social impacts	Proposed mitigation measures	Responsible for implementing the mitigation measures	Time Horizon	Indicative Budget for implementation (USD)
	WHO laboratory bio-safety manual 3rd Edition which includes: - Adequate spaces for woks and staff - Accessible to people with disability and others with special needs - Infectious diseases and occupational health hazards prevention and control systems - Emergency management systems - Waste disposal systems		Construction Phase	
Impactson Landscape	- The construction wastes and packaging materials would be regularly collected, transported and properly disposed on a site designated for this purpose to minimize impacts. - Use dust-suppressing water spray during civil works, where necessary	- Construction Contractor	Construction Phase	Budget included in project cost
Soil erosion due to clearance of vegetation and movement of heavy construction machineries.	Implement appropriate methods as recommended in the WBG EHS guideline - Reducing or preventing erosion by: contouring and minimizing length and steepness of slopes, mulching to stabilize exposed areas, re-vegetating areas promptly, - Limit extent of vegetation clearing on construction sites, materials mining sites, working areas and service roads - Control movement of vehicles; Light construction machinery would be used and excavation would be strictly carried out within the space provided in the layout - Regular use of water sprays and compacting soil on earth roads and around working areas - Re-plant trees and vegetation after construction	EFDA/MOH	Construction Phase	Budget included in project cost
ImpactonGeology/Soils	Soil erosion prevention measures would be in place during the construction phase to minimize erosion from storm water;			Budget include d in

Potential environmental &social impacts	Proposed mitigation measures	Responsible for implementing the mitigation measures	Time Horizon	Indicative Budget for implementation (USD)
	Dust suppression measures would be employed to minimize wind erosion.			project cost
Change in natural drainage flow pattern and surface water runoff Drainage clogging from rubble, cement, paints, lubricants and fuels as well as makeshift toilets	- Use WBG EHS guideline recommendation for the septic systems - Collect and dispose wastes in designated disposal sites as required by the Local Authority - Keep all drains clear of silt and debris regularly and after construction	- Construction Contractor		Budget include din project cost
Temporary loss of access to services such as water telephones and electricity due to possible damage by contractor	- Identify and divert locations water pipes, telephone and electric cables before construction and relocate laboratory equipment's to a room reasonably away from construction activities	- Construction Contractor & supervisor - EFDA/MOH	During Construction Phase	Budget included in project cost
Spread of HIV and other contagious diseases due to human contact among the construction work force.	- Sensitizing workers and the surrounding communities on awareness, prevention and management of HIV/AIDS. Distribute condoms and create awareness on the transmission mechanisms of contagious diseases	- Construction Contractor & supervisor - EFDA/MOH	During Construction Phase	Budget included in project cost
Intensification of Malaria	- Prevention of larval and adult propagation through sanitary improvements and elimination of breeding habitats close to human settlements. - Drain all pools of standing water to minimize or altogether eliminate mosquito breeding sites	- Construction Contractor & supervisor - EFDA/MOH	During Construction Phase	Budget included in project cost
Spread of COVID-19	- Sensitizing workers and the surrounding communities on awareness, prevention and management of COVID-19 - Provide training and onsite covid prevention services to construction crew - Apply ESF/Safeguards Interım Note: COVID-19 Consıderatıons ın Constructıon/Cıvıl Works Projects will be practiced	- Construction Contractor & supervisor - EFDA/MOH	During Construction Phase	Budget included in project cost

Potential environmental &social impacts	Proposed mitigation measures	Responsible for implementing the mitigation measures	Time Horizon	Indicative Budget for implementation (USD)
Gender empowerment	- Ensuring equitable distribution of employment opportunities between men and women - Providing toilets and bathrooms for both male and female workers on site	- Construction Contractor & supervisor - EFDA/MOH	During Construction Phase	Budget included in project cost
Child Labor and Protection	- Provide and implement a child protection strategy - Ensuring no children are employed on site in accordance with national and international labor laws - Ensuring that any child sexual relations offenses among contractors' workers are promptly reported to the police	- Construction Contractor & supervisor - EFDA/MOH	During Construction Phase	Budget included in project cost
Gender Equity, Sexual Harassment	- Provide and implement a gender-based violence strategy, which will include: • Gender mainstreaming in employment at the worksite with opportunities provided for females to work, in consonance with local laws and customs • Grievances redress mechanisms including non-retaliation. • Provide and implement an employee code of conduct - 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	- Construction Contractor & supervisor - EFDA/MOH	During Construction Phase	Budget included in project cost
Air pollution due to emissions from construction machinery and from dust	Applying Dust suppression techniques as recommended in WBG EHS guideline - Water would be sprayed on access roads and construction sites and loose soil would be compacted and construction machinery would be regularly maintained as recommended by dealers	- Construction Contractor	During Construction Phase	Budget included in project cost
Noise & vibration disturbances due to movement of heavy plant and equipment	- Planning activities in consultation with local communities - Construction activities during night time would be avoided. - Use of personal protective clothing (PPE) like hearing	- Construction Contractor	During Construction Phase	Budget included in project cost

Potential environmental &social impacts	Proposed mitigation measures	Responsible for implementing the mitigation measures	Time Horizon	Indicative Budget for implementation (USD)
	protection on construction crew. - No discretionary use of noisy machinery within 50 m of residential areas and near institutions or use of manual labor in these sections. - Good maintenance and proper operation of construction machinery.			
Temporary obstruction of walkways due to road and sidewalk barriers	- Provide alternative routes and passages with adequate and appropriate directional signs	- Construction Contractor	During Construction Phase	Budget included in project cost
Impact of improper construction and demolition waste management	- The wastes will be properly segregated and separated - The contractor and EFDA/MOH administration will work together with the Municipal Council to facilitate proper waste handling and disposal from the site. - Hazardous waste will not be mixed with other solid waste generated and would be managed by way of incineration or land-filling. - Waste will be picked off the site every day and when temporarily kept on site it will be covered	- Construction Contractor - Construction supervisor	During Construction Phase	2,000.00
Impacts from physical hazards	- Orientation would be provided to all construction workers on safe work practices and guidelines and ensure that they adhere to them. - Training on incidences handling and prevention would be provided to workers.	- Construction Contractor - Construction supervisor	During Construction Phase	7,000.00

Potential environmental &social impacts	Proposed mitigation measures	Responsible for implementing the mitigation measures	Time Horizon	Indicative Budget for implementation (USD)
	- Regular drills would constantly follow on various possible incidences. - Use of signage to warn staff and/ or visitors that are not involved in construction activities of dangerous places. - Safety supervision of works would be done regularly to ensure that safety conditions are met - Evacuation procedures will be developed to handle emergency situations. - Provide appropriate personnel protective equipment (PPE) to all workers.			
Impact from traffic accidents due to moving machinery	- Planning & segregating the location of vehicle traffic, machine operation, & walking areas, and controlling vehicle traffic through the use of one-way traffic routes, - Establishment of speed limits, and on-site trained flag people wearing high-visibility vests or outer clothing covering to direct traffic - Adopt best transport safety practices - Provide on-site training to drivers, machine operators, and traffic controller about traffic accident Employee safe traffic control measures	- Construction Contractor	During Construction Phase	8,000.00

Potential environmental &social impacts	Proposed mitigation measures	Responsible for implementing the mitigation measures	Time Horizon	Indicative Budget for implementation (USD)
	- Develop vehicle traffic plan to minimize traffic accidents			
Impact on Air quality	- Contractors should use dust screens or nets in windows, doorways and ventilators of rooms where demolition or other dusty construction activities are occurring. - Ensure good housekeeping and clean construction operations where, among other necessary actions, dust would be quickly swept off cement floors and collected in covered containers. - EFDA administrator will have the authority to inspect and restrain contractors from generating excessive dust within institute environment - To minimize indoor dust, portable extraction systems are recommended. - Avoid water sprays: this could lead to indoor flooding of surrounding rooms	- Construction Contractor	During Construction Phase	Budget included in project cost
Impact on social service caused by disruption of laboratory services	- Construction activities would be carried out during the day time - Plan pre-construction activities early to identify suitable rooms or adjoining buildings into which the sample	ConstructionContractor Construction supervisorPIU	DuringConstructionPhase	Budget includedinprojectcost

Potential environmental &social impacts	Proposed mitigation measures	Responsible for implementing the mitigation measures	Time Horizon	Indicative Budget for implementation (USD)
	collection can be carried out with minimal inconvenience			
Impacts of gender based violence and child labour	- Give priority for women in the employment of skilled and casual laborers - Provision and availability of separate sanitation facilities for women, the provision of women friendly safety equipment and materials, - Contract document for workers should incorporate measures to be taken against those workers who commit GBV and sexual harassment. - Establish a standard code of conduct to be produced by the client and signed by all workers including subcontract workers. - As part of prevention, provide orientation on SEA/SH and signing of code of conduct by subproject workers - Take appropriate actions on workers violating the CoC; - Ensure that no child is employed on site in accordance with national labour laws; - Ensure that any child abuse attempts or practices including sexual offenses among contractors' workers are promptly reported to the police	Construction ContractorConstruction supervisorPIU	DuringConstructionPhase	Budget includedinprojectcost

Potential environmental &social impacts	Proposed mitigation measures	Responsible for implementing the mitigation measures	Time Horizon	Indicative Budget for implementation (USD)
	- The Contract must follow strict measures against the employment of children - In the contract document must clearly stipulate that it is against the law to employ under age children - If the contractor is found employing children below the legally required age, he/she should be penalized and compensate the child. - Regular monitoring should be conducted to ensure that no child labour is used in the construction work - Ensure provision and enforcement of all relevant labour laws, regulations, tools and contractual agreements (Employment Act, OSH Act, Workers' compensation, Labour Unions Act etc.) in all workplaces - Empower and facilitate Labour Inspection Function to monitor implementation of relevant policies and legal instruments			
Archaeological Artefacts and Cultural Chance Finds within the Project Site during construction	• Implementation of Chance Find Procedure (see Section 10.1) and training of the construction workers • Report chance finds immediately to Addis Ababa City Administration Museum and Monuments Protection	Contractor	Regularly during construction	Included in construction cost

Potential environmental &social impacts	Proposed mitigation measures	Responsible for implementing the mitigation measures	Time Horizon	Indicative Budget for implementation (USD)
	Department			
Operation phase*				
Positive impact				
Ensured public health via regulating food, drug and medical equipment quality, efficacy & performance	- Construction of vaccine lab would be strengthen regulation of imported, local industry products, drug, vaccine and medical equipment's	EFDA and MOH	During Operation Phase	Budget included in project cost
Generation of additional permanent employment	- Operation of the lab will create additional permanent technical and non-technical job opportunities for different professionals, and supportive personnel.	EFDA and MOH	During Operation Phase	Covered by GoE during operation of the project
Negative Impact				
Occupational health and safety risks	- Provide personal Protection equipment - Implement engineering control systems like primary and secondary barriers - Organize and implement medical surveillance which includes medical service and immunization programs - Provide health and safety training - Adopting and implementing safety manuals aligned with OSH guideline and WHO laboratory biosafety manual. - Develop and implement safety standards.	EFDA/MOH	During Operation Phase	1,000 per annum

Potential environmental &social impacts	Proposed mitigation measures	Responsible for implementing the mitigation measures	Time Horizon	Indicative Budget for implementation (USD)
	i) **Risk of Infection Mitigation Measures** ➢ Laboratory personnel working in vaccine labshould receive specific training in handling chemicals and potentially lethal agents and would be supervised by competent staff in handling infectious agents and associated procedures, ➢ All procedures involving the manipulation of infectious materials should be conducted within a BSC, or other physical containment devices, ➢ Persons would wash- their hands after working with potentially hazardous materials and before leaving the laboratory, ➢ Spills involving infectious materials would be contained, decontaminated, and cleaned up by staff properly trained and equipped to work with infectious material, ➢ Equipment would be decontaminated before repair, maintenance, or removal from the laboratory, ➢ Workers in the laboratory should wear protective laboratory clothing with a solid-front, such as tie-back or wrap-around			

Potential environmental &social impacts	Proposed mitigation measures	Responsible for implementing the mitigation measures	Time Horizon	Indicative Budget for implementation (USD)
	gowns, scrub suits, or coveralls. Protective clothing will not be worn outside of the laboratory, ➢ Reusable clothing should be decontaminated before being laundered. Clothing is changed when contaminated, ➢ Potentially infectious materials should be placed in a durable, leak proof container during collection, handling, processing, storage, or transport within a facility, ➢ Gloves should be worn to protect hands from exposure to hazardous materials. Gloves should not be worn outside the laboratory. Dispose of used gloves with another contaminated laboratory waste. Hand washing protocols would be rigorously followed,			
	ii) **Chemical Hazards Mitigation Measures** ➢ To avoid accidental leakage or spillage, secondary containers, such as leak proof boxes, should be used, fitted with racks so that the specimen containers remain upright, ➢ Respiratory protection should be used when carrying out high-hazard procedures. The choice of respirator will depend			

Potential environmental &social impacts	Proposed mitigation measures	Responsible for implementing the mitigation measures	Time Horizon	Indicative Budget for implementation (USD)
	on the type of hazard(s) and it be available with interchangeable filters for protection against gases, vapors, particulates and microorganisms ➢ Volatile solvents should be handled in chemical hood, ➢ Material Safety Data Sheets (MSDS) or equivalent should be considered while handling, storing, using, and disposing hazardous chemicals. ➢ Only small amounts of chemicals necessary for daily use should be stored in the laboratory, ➢ Where corrosive, oxidizing, or reactive chemicals are used, handled, or stored, qualified first-aid would always be ensured. ➢ Either a fully buttoned laboratory coats, gowns, coveralls, or a long-sleeved, back opening gowns or coveralls should be used in vaccine lab. Aprons may also be worn over laboratory coats or gowns where necessary to give further protection during handling of chemicals, hazardous and infectious materials, and			

Potential environmental &social impacts	Proposed mitigation measures	Responsible for implementing the mitigation measures	Time Horizon	Indicative Budget for implementation (USD)
	➢ Eye and face protection (goggles, mask, face shield or other splash guard) would be used for anticipated splashes or sprays of infectious or other hazardous chemical materials.			
	iii) Risk of Burn or Fire Mitigation Measures ➢ Prepare a fire safety plan and the plan should provide employees or building occupants with the instructions they need to leave the building (or respond as appropriate) in the event of a fire, ➢ Delineating fire and emergency assembly points and creating awareness to ensure all people at site are aware of them, e.g. through the use maps on elevators, staircases etc. ➢ All laboratory electrical equipment would be earthed/grounded, preferably through three-prong plugs, ➢ Combustible materials such as flammable liquids, solid materials should be stored in lockable cupboard, ➢ Fire hazard signs such as 'No Smoking' signs will be provided. Directions to exit in case of any fire incidence and emergency contact numbers will be provided. The contact/emergency numbers will be displayed within the laboratory			

Potential environmental &social impacts	Proposed mitigation measures	Responsible for implementing the mitigation measures	Time Horizon	Indicative Budget for implementation (USD)
	➢ First aid treatment facility should be also available, ➢ Automatic fire alarm system for the entire laboratory will be installed, ➢ All staff will have training in fire control through regular fire fighting drills. ➢ Fire extinguishers should be available in accessible area near to fire risk area and ensure that all fire-fighting equipment is regularly maintained and serviced,			
	iv) Ergonomic Hazards Mitigation Measures ➢ Training of workers in lifting and materials handling techniques during operation, including the placement of weight limits above which mechanical assists or two-person lifts are necessary, ➢ Planning work site layout to minimize the need for manual transfer of heavy loads, ➢ Selecting tools and designing work stations that reduce force requirements and holding times, and which promote improved postures, including, where applicable, user adjustable work stations,			

Potential environmental &social impacts	Proposed mitigation measures	Responsible for implementing the mitigation measures	Time Horizon	Indicative Budget for implementation (USD)
	➢ Implementing administrative controls into work processes, such as job rotations and rest or stretch breaks.			
	v) Injury/Accident Mitigation Measures ➢ Injuries should always be reported to supervisors and victims should get medical attention as soon as possible. Collect broken needles in secured and safe area and dispose all based on WHO standard, ➢ Sharps waste by disposing of it in a sealable container; self-locking and sealable sharps containers are made of plastic so that the sharps cannot easily penetrate through the sides. Such units are designed so that the whole container can be disposed of with other bio hazardous waste, with the support of the government ➢ Hepatitis B Vaccine should be given for all workers work in laboratory			
	Vi) Risk related to Electricity Mitigation Measures ➢ It is essential that all electrical installations and equipment are inspected and tested regularly, including earthing/grounding systems. Circuit-breakers and earth-fault-interrupters should			

Potential environmental &social impacts	Proposed mitigation measures	Responsible for implementing the mitigation measures	Time Horizon	Indicative Budget for implementation (USD)
	be installed in appropriate laboratory electrical circuits, ➢ All laboratory electrical equipment would be earthed/grounded, preferably through three-prong plugs, ➢ All laboratory electrical equipment and wiring would conform to national electrical safety standards and codes , ➢ Disconnect equipment attached to high-voltage or high-amperage power sources from the source or provide a lockout device on the breaker box to prevent circuit activation before maintenance is performed, ➢ Because electrical devices can generate sparks, do not use them near flammable or volatile gases or liquids, ➢ Never place flammable liquids in a household refrigerator. The spark generated by the door-activated light switch can ignite fumes trapped in the unit, causing an explosion and fire, ➢ Specialized refrigerators would be used when storing chemicals that have explosion potential			
Improper waste management can lead water and soil contamination	- Provide colour coded waste bins for the different types of waste generated - Develop and implement appropriate plan, strategies and action plan for waste minimization and segregation - Use appropriate facilities and methods as stipulated in the	EFDA/MOH	DuringOperation Phase	2,500 per annum

Potential environmental &social impacts	Proposed mitigation measures	Responsible for implementing the mitigation measures	Time Horizon	Indicative Budget for implementation (USD)
	WBG EHI guideline to collect, and transport wastes, treat and dispose them using appropriate technologies and disposal facilities such as incineration, autoclave and sanitary landfill - Laboratory staff s and supportive staffs would be trained on waste management and handling during operation - Laboratory would have standard operation and decontamination procedure manuals and clearly displayed at appropriate point (s) with the laboratory - Use WBG EHS guideline recommendations for the septic systems - Use appropriate waste drainage system leading to septic tank or public sewerage facilities or treatment technologies such as activated sludge and sanitary facilities, if available the town municipality - Use contingency containment facilities to collect accidental health care waste spillage - Training workers on the correct transfer and handling of fuels and chemicals and the response to spills - Provide emergency materials like chemical and biological spill kits and MSDS. - Proper selection of disposal sites - Adhering to recommended waste disposal practices (i.e. WBG EHS guideline)			
Impacts from physical hazards	- All workers to be provided with appropriate PPE against exposure to infectious pathogens, hazardous chemicals and	EGFDA	During	10,000.00Per

Potential environmental &social impacts	Proposed mitigation measures	Responsible for implementing the mitigation measures	Time Horizon	Indicative Budget for implementation (USD)
	ionizing radiation in accordance with recognized international safety standards and guidelines. - Orientation for all staff would be given on safe work practices and guidelines and ensure that they adhere to it. - Training would be conducted on incident handling and prevent manage. This would involve proper handling of electricity, water etc. and sensitization on various modes of escape, conduct and responsibility during such incidences. - Regular drills would constantly follow on various possible incidences. This will test the response of the involved stakeholders. Such drills will keep them alert and they will become more responsive to in the case of incidences. - Use signage to warn staff and/or visitors that are not involved in laboratory work of dangerous places - Develop evacuation procedures to handle emergency situations.	Management &HSE Officer	Operation Phase	annum.
Impact from Electrical and Explosive Hazards	• All electrical installations and equipment would be inspected and tested regularly, including earthing/ grounding systems. • Circuit-breakers and earth-fault-interrupters would be	EFDA	During Operation - phase	Budget included theconstruction

Potential environmental &social impacts	Proposed mitigation measures	Responsible for implementing the mitigation measures	Time Horizon	Indicative Budget for implementation (USD)
	installed • All laboratory electrical equipment would be earthed /grounded, Disconnectequipmentattachedtohigh-voltageorhigh-amperagepowersources • Never place flammable liquids in ahouse hold refrigerator.			
Impact from Chemical Hazard	• Only small amounts of chemicals necessary for daily usewouldbestoredinthelaboratory. • Replacementofthehazardoussubstancewithalesshazardoussubstitute • Implementation of engineering and administrative controlmeasures to avoid or minimize the level of exposurebelowinternationallyestablishedorrecognizedlimits • Where corrosive, oxidizing, or reactive chemicals areused,handled,orstored,qualifiedfirst-aidwouldalwaysbe ensured. Appropriately equipped first-aid stationswouldbeeasilyaccessiblethroughouttheplaceofwork,and eye-wash stations and/or emergency showers wouldbe provided close to all workstations where therecommended first-aid response is immediate flushingwithwater	EFDA	DuringOperationphase	15,000.00

Potential environmental &social impacts	Proposed mitigation measures	Responsible for implementing the mitigation measures	Time Horizon	Indicative Budget for implementation (USD)
	• Material Safety Data Sheets (MSDS) or equivalent. Any means of written communication would be in an easily understood language and be readily available to exposed workers and first-aid personnel • Training workers in the use of the available information (such as MSDSs), safe work practices, and appropriate use of PPE			
Impact of escaping of Infectious Agents from vaccine lab	• Personnel working in vaccine lab would be trained on sample and waste handling, transportation, and storage • Equipment would be maintained and calibrated periodically • BSCs HEPA filters would be tested annually and replaced as necessary. • Effective vaccines or therapeutic measures would be available for all risk groups • All material would be sterilized by autoclave or chemical disinfection would be locked always, and access restricted for non-authorized personnel • All agents would be contained within the laboratory and	EFDA	During Operation phase	1,000.00

Potential environmental &social impacts	Proposed mitigation measures	Responsible for implementing the mitigation measures	Time Horizon	Indicative Budget for implementation (USD)
	bio security system would be in place.			
Potential Occupational Health and safety impacts with operation	• Implement the facility containment devices, and administrative controls • Implement special practices for the facilities • Use Personal Protective Equipment during performing activities • Use Secondary Barriers • Check HEPAs periodically	EFDA	During Operation phase	8,000.00
Potential impacts associated with operation of vaccine lab	• All procedures involving the manipulation of infectious materials would be conducted within BSCs or other physical containment devices and the vaccine lab would have special engineering and design features. • Personnel working in the lab would receive specific training in handling pathogenic and potentially lethal agents and would be supervised by competent staff in handling infectious agents and associated procedures	EFDA	During Operation phase	2,500.00

Potential environmental &social impacts	Proposed mitigation measures	Responsible for implementing the mitigation measures	Time Horizon	Indicative Budget for implementation (USD)
Impact of handling and storage of vaccine, materials and specimens in the proposed lab	• Use robust and leak-proof specimen containers • Containers would be correctly labeled to facilitate identification. • Specimen request or specification forms would not be wrapped around the containers but placed in separate, preferably water proof envelopes. • Secondary containers, such as boxes, would be used, fitted with racks so that the specimen containers remain upright.	- EFDA	DuringOperation phase	2,500.00
Impact associated with the use of equipment	• Trainingofworkersinequipmentoperatingandhandlingtechniquesduringoperation. • Periodic maintenance and calibration of equipment according to manufacturer commendation. • Operation of equipment according to the manufacturer' s instructions	- EFDA	DuringOperation phase	1,000.00
Potential impact during theoperationof store/Warehouse	• Replacement of the hazardous substance with a less hazardous substitute • Implementation of engineering and administrative control measures	EFDA	DuringOperationPhases	2,000.00per annum

Potential environmental &social impacts	Proposed mitigation measures	Responsible for implementing the mitigation measures	Time Horizon	Indicative Budget for implementation (USD)
	• Appropriately first-aid stations would be easily accessible to all workstations • Keeping the number of employees exposed, or likely to become exposed, to a minimum • Communicating chemical hazards to workers through labeling and marking • Material Safety Data Sheets (MSDS), would be in an easily understood language and be readilyavailable • Training workers in the use of MSDSs, safe work practices, and appropriate use of PPE • Store chemicals in a well-ventilated area; however, do not store chemicals in a fume hood. • Maintainaninventoryofallchemicalsin storage. • Return chemical containers to their proper storage location after use. • Store glass chemical containers so that they are unlikely to be broken. • Store all hazardous chemicals below eye level. • Never store hazardous chemicals in a public area or corridor.			

Potential environmental &social impacts	Proposed mitigation measures	Responsible for implementing the mitigation measures	Time Horizon	Indicative Budget for implementation (USD)
	• Separate acids from bases. Store these chemicals near floor level. • Isolate perchloric acid from organic materials. Do not store perchloric acid on a wooden shelf. • Separate highly toxic chemicals and carcinogens from all other chemicals. This storage location should have a warning label and should be locked. • Separate acids from flammables. • Not keep peroxide-forming chemicals longer than twelve months. • Not allow picric acid to dry out. • If flammables need to be chilled, store them in a laboratory-safe refrigerator, not in a standard refrigerator. • Flammables would be stored in a flammable storage cabinet. • Store reactive materials separate from corrosives or flammables. • Store Nitric acid (reactive and corrosive) separately from other acids and flammables. • Storage location would clearly indicate which group/code is			

Potential environmental &social impacts	Proposed mitigation measures	Responsible for implementing the mitigation measures	Time Horizon	Indicative Budget for implementation (USD)
	stored in that location. Each shelf or cabinet should indicate the colour. • Groups would always be separated by a vertical divider not horizontal divider. • Each chemical container would be clearly labelled by it storage colour			
Ergonomic Hazards	Training of workers in lifting and materials handling techniques during operation, • Planning work site layout to minimize the need for manual transfer of heavy loads • Selecting tools and designing work stations that reduce force requirements and holding times	- EFDA	DuringOperationphase	1,000.00
Impact of Air pollution due towasteincineration	• Waste segregation for wastes with polychlorinatedbiphenyls (PCB) wouldbedoneandthesewasteswouldneverbeincinerated, • Materials free of polychlorinated would be purchased, forminimizingtheenvironmentalandhealthimpacts. • WorkerswillbeprovidedwithPPEandtheuseofPPE wouldbeenforced. • Improveincineratorsand infrastructurefor healthcare	Facilities Administration. EFDA Supplier oftheincinerator	DuringOperationphase	5,000.00

Potential environmental &social impacts	Proposed mitigation measures	Responsible for implementing the mitigation measures	Time Horizon	Indicative Budget for implementation (USD)
	wastetreatment and disposal • Maintain the incinerator speriodically • Purchasenewenvironmentallyfriendlyincineratorseeannex7forspecifications			
NoiseandVibration	• Allgeneratorsandlaboratoryequipmentwillbeinsulated or placed in enclosures to minimize disrupting ambientnoiselevels.	EFDA	During Operationphase	-
Misuse and/or theft vaccines andequipment/supplies	• Strict Biosecurity measures would be implementedtolimit access to facilities, research materials andinformation. • Continuetheuseofdigitalinventorysystemforboththemicroorganismsandequipment. • Developmeasuresto protectagainstthe insiderthreat (Employees, staff, or contractors), or outsider threat(outsiderswhointendtogainaccesstodoharm)andanynaturalormanmadeeventsthatcouldcausearelease. • Establishsystemforphysicalsecurity,personnelsecurity, material control & accountability, andinformationsecurity • Allstaffwillhavetraininginlaboratorysecurityand biosecurity.	- EFDA	DuringOperationPhase	1,500.00

Potential environmental &social impacts	Proposed mitigation measures	Responsible for implementing the mitigation measures	Time Horizon	Indicative Budget for implementation (USD)
GenderBasedViolenceImpacts	• Conductcontinuedsensitizationand awarenessraisingtoEFDA staff onpreventionofGBV. • Strengthen the Gender and women office of EFDA toaddressGBVcaseswhenitoccurs.	- EFDAwomenand youthoffice	DuringOperatio nPhase	2,500.00
ImpactduetoImproper solid WasteManagement	• Develop and implement a waste management plan for EFDA • Initialpackagingand storagewouldtake placewherelab wasteisgenerated. • Storage of waste will then be moved to a temporary on-sitestoragelocation • Non-risk lab waste would always be stored in a separatelocation from the infectious/ hazardous lab waste in order toavoidcross-contamination. • Strengthen the internal waste management system(collection,storageanddisposal)ofthevaccine labandequipitwithadditional facilities to allow for segregatedcollectionatsource. • All sharps used in the lab would be autoclaved prior tincineration. • Sharpswouldbeplacedinrigid,puncture-resistant containers	- EFDA	DuringOperatio nPhase	570,000

Potential environmental &social impacts	Proposed mitigation measures	Responsible for implementing the mitigation measures	Time Horizon	Indicative Budget for implementation (USD)
	made of glass, metal, rigid plastic, orcardboard. • Liquid infectious wastes would be placed in capped ortightlystoppedbottles orflasks;largequantitiesmaybeplacedincontainmenttanks. • Solid or semisolid wastes would be placed in tear-resistant plastic bags judged by their thickness ordurability. • There would be special packaging characteristics forsome treatment techniques: incineration requirescombustiblecontainers,andsteamsterilizationrequire spackaging materials that allow steam penetration andevacuationofair. • Solid waste generated in the proposed facility wouldleave the laboratories only after decontamination usingthelaboratory'sautoclave. • Non-hazardouswastesthataregeneratedbytheproposed facility wouldbeincinerated. • Liquid Waste discharged from laboratory would be directly linked to treatment plant treated • Liquid waste treatment plant would be constructed at the lab compoundtoimprovethecapacityofthewaste treatment.			

Potential environmental &social impacts	Proposed mitigation measures	Responsible for implementing the mitigation measures	Time Horizon	Indicative Budget for implementation (USD)
	• Provideappropriatewastebins(colourcoded)forthe differenttypesofwastegeneratedtoallow segregation and collection at the point ofgeneration. • Laboratorystaffandallotherstaffinvolvedinwastehandlingwouldbetrainedonthewastehandling treatment,anddisposaltechniques. • Fumigation of the laboratory by disinfectant gases wouldbeconductedaccordingtoWHOlaboratorymanual. • Regularvisualinspectionofallwastestoragecollection & storage areas for evidence of accidental releases andtoverifythatwastesareproperlylabeledandstored. • Regularauditsofwastesegregationand collectionpractices. • Trackingofwastegenerationtrendsbytypeandamountofwaste generated,preferablybyfacilitydepartments. • Keepingmanifestsorotherrecordsthatdocumentthe amountofwastegeneratedanditsdestination.			
Impactassociated withcollection/handlingandstorage ofwaste	• Develop and implement a waste management plant for the laboratory in general and for the proposed project • Initialpackagingand storagewouldtake placewherelab waste isgenerated.	- EFDA	DuringOperationPhase	10,000

Potential environmental &social impacts	Proposed mitigation measures	Responsible for implementing the mitigation measures	Time Horizon	Indicative Budget for implementation (USD)
	• Storage of waste will then be moved to a temporary on-sitestoragelocation • Non-risklab wastewouldalwaysbestoredinaseparate location from the infectious/ hazardous lab waste in order toavoidcross-contamination. • Strengthen the internal waste management system(collection, storage and disposal) of the vaccine lab and equip itwithadditionalfacilities to allow for segregatedcollectionatsource. • All sharps used would be autoclaved priortoincineration. • Sharpswouldbeplacedinrigid,puncture-resistant containers made of glass, metal, rigid plastic, orcardboard. • Liquid infectious wastes would be placed in capped ortightlystoppedbottles orflasks;largequantitiesmaybeplacedincontainmenttanks. • Solid or semisolid wastes would be placed in tear-resistant plastic bags judged by their thickness ordurability. • Solid waste generated wouldleave the laboratories only after decontamination usinglaboratory'sautoclave. • Non-hazardouswastesgeneratedwouldbeincinerated.			

Potential environmental &social impacts	Proposed mitigation measures	Responsible for implementing the mitigation measures	Time Horizon	Indicative Budget for implementation (USD)
	• LiquidWastedischargedfromlaboratorywould be treated chemically prior to being released to the wastetank. • Liquid waste treatment plant would be constructed atvaccine laboratorytoimprovethecapacityofthetank. • Laboratorystaffandallotherstaffinvolvedinwastehandling would be trained on the waste handlingtreatment,anddisposaltechniques. • Fumigation of the laboratory by disinfectant gases wouldbeconductedaccordingtoWHOlaboratorymanual. • Regular visual inspection of all waste storage collectionand storage areas for evidence of accidental releases andtoverifythatwastesareproperlylabelledandstored. • Regularauditsofwastesegregationand collectionpractices. • Trackingofwastegenerationtrendsbytypeandamount ofwastegenerated,preferablybyfacilitydepartments. • Keeping manifests or other records that document theamountofwastegeneratedanditsdestination.			
Risk associated with off-site transportofwaste	• The vaccine lab would follow applicable national regulations andinternationally accepted standards for packaging,labeling,andtransportofhazardousmaterialsandwast		DuringOperatio nPhase	8,000

Potential environmental &social impacts	Proposed mitigation measures	Responsible for implementing the mitigation measures	Time Horizon	Indicative Budget for implementation (USD)
	es • All waste containers designated for off-site shipmentwould be secured and labeled with the contents andassociated hazards, be properly loaded on the transportvehicles before leaving the site, and be accompanied by ashipping paper (i.e., manifest) that describes the load anditsassociatedhazards • The vaccine lab would use tanks and containers specially designedand manufactured to incorporate features appropriate forthewastestheyareintendedtocarry • The vaccine lab would adequately label all transport tanks andcontainers to identify the contents, hazards, and actionsrequiredinvariousemergencysituations. • Thewastewouldbeplacedinrigid,leak-proofcontainers before beingloaded. • Containerswouldbecoveredwithlidsduringtransportation. • When transportingplastic bagsofinfectiouswaste,care shouldbetakentopreventtearingthebags. • Vehiclesusedfortransportinginfectiouswaste wouldbedisinfectedpriortouseforanyotherpurpose. • Thevehiclesshallcarryadequatesuppliesofplasticbags,protectiv	- EFDA - Addis Ababamunicipalwastemanagementauthority		

Potential environmental &social impacts	Proposed mitigation measures	Responsible for implementing the mitigation measures	Time Horizon	Indicative Budget for implementation (USD)
	e clothing, cleaning tools, and disinfectants tocleananddisinfectincaseofanyspills. • Recordsmustbekeptdocumentingalltransportof medicalwaste			
Risk associated with solid wasteTreatmentatEFDA	• Wastesegregationforwasteswithpolychlorinateddibenzo-dioxinsandpolychlorinateddibenzo-furansPCDD/Fswouldbedoneandthesewasteswouldneverbeincinerated, • Workers would be provided with PPE usagewouldbeenforced.	- EFDA - Addis Ababamunicipalwastemanagementauthority	DuringOperationPhase	5,000.00
EmergencyPreparednessandResponse	• Organization ofemergencyareas • Communicationsystems • Emergencyresponseprocedures • Trainingandupdating • Checklists(roleandactionlist andequipmentchecklist) • BusinessContinuityandContingency	-		4,500.00
Archaeological Art-facts and Cultural Chance Finds within the Project Site	• Implementation of Chance Find Procedure (see Section 10.1) and training of the construction workers • Report chance finds immediately to Addis Ababa City Administration Museum and Monuments Protection	EFDA/MOH	Regularly during Operation	Included in construction cost

Potential environmental &social impacts	Proposed mitigation measures	Responsible for implementing the mitigation measures	Time Horizon	Indicative Budget for implementation (USD)
	Department			
Totalcost			**667,500.00**	

8. ENVIRONMENTAL AND SOCIAL MANAGEMENT MONITORING PLAN

The overall objective of environmental and social monitoring is to qualitatively and quantitatively measure effectiveness of mitigation measures, and develop appropriate responses to incompliances with Project standards, and emerging environmental and social issues. Monitoring will be carried out to ensure that all Project activities and mitigation measures comply with the national legislation and the World Bank; responsible bodies meet their commitments and requirements of this ESMP in terms of periodical audits and reporting. The main objectives of developing a monitoring program and defining parameters are to;

- Ensure that all mitigation measures are properly implemented ,
- Measure effectiveness of the mitigation measures,
- Provide mechanisms for taking timely action when unexpected environmental and social incidents are encountered, and
- Identify training requirements at all levels of the organizational structure.

8.1. Institutional Arrangement for Monitoring Plan Implementation

Monitoring will verify if predicted impacts have actually 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 MOH/ESD directorate, EFDA and representative of Addis Ababa EPA at city administration level or sub city and/or Woreda level (such as Woreda 05). Monitoring by EPA in this case can be considered “third party monitoring” but this is its regulatory mandate according to Pollution Control Proclamation. Another government agency that may undertake “third party monitoring” is the Occupational Health & Safety Department of Addis Ababa Labor and Social Affairs Bureau. It has authority to inspect any facility for compliance with national requirements on safety in workplaces. Monitoring will be done through site inspection, review of grievances logged by stakeholders and ad hoc discussions with potentially affected persons (construction workers, residents near the institute, patients and healthcare staff).

8.2. Annual Audit

Annual Audit is an independently commissioned environmental and social audit that will be carried out on an annual basis, as required. Annual Audit of the ESIA implementation will be undertaken by independent external consultants. The reviews amongst other things will assess the performance of program activities against safeguards procedures described in this ESIA, the need for future training, and existing status of implementation of environmental and social safeguards measures to address the corresponding impacts due to implementation of the project.

The Annual Audit also provides a strong incentive for MOH to ensure that the ESIA is implemented and the project ESMPs and other required safeguards instruments are developed and implemented, as recommended. An Annual Audit Report will include a summary of the environmental and social safeguards performance of the Vaccine labs, based on the project ESMPs and measures indicated in the ESIA; presentation of compliance and progress in the implementation of the project ESMPs; and a synopsis of the environmental monitoring results from individual project monitoring measures (as set out in the project ESMPs), at project level.

The main tasks of the audit study will consider, but not limited to:

- Description of the project, Objective, Scope and Criteria of the Audit;
- Verify the level of compliance by the proponent/IPP with the conditions of the environmental management and social management plan;
- Evaluate the proponent's knowledge and awareness of and responsibility for the application of relevant legislation;
- Review existing project documentation related to all project facilities and designs under REGREP;
- Examine monitoring programs, parameters and procedures in place for control and corrective actions in case of emergencies;
- Examine records of incidents and accidents and the likelihood of future occurrence of the incidents and accidents;
- Inspect areas where project equipment and materials are stored and disposed of and give a record of all significant environmental risks associated with such activities;
- Examine and seek views on health and safety issues from the project staffs, the local and other potentially affected communities; and

- Prepare a list of health, safety, environmental and social including gender concerns of past and on-going activities.

MoH must submit on time annual audit report to World Bank.

8.3. Reporting System

Monthly monitoring reports should be compiled by EFDA's Project Coordination Team and shared with FMoH and EFDA or another interested stakeholder. Construction- and post-construction phase auditing should finish in reports that MOH shall share with EFDA or other interested stakeholders. Note that while MOH is under obligation to disclose construction phase audits, annual post-construction audits must be submitted to Addis Ababa EPA as a guideline requirement as per EIA Proclamation, 299/2002.

8.4. Monitoring Plan

Environmental and social management plan monitoring needs to be carried out during the construction as well as operation and maintenance of the sub-projects to ensure that mitigation measures are implemented, have the intended result, and that remedial measures are undertaken, if mitigation measures are inadequate or the impacts have been underestimated within the environmental and social Assessment (Table 11).

At the Project implementation unit, an environmental and social safeguards specialist will be assigned will be responsible for overseeing safeguards compliance during construction and operation of the vaccine lab building. The specialist will be responsible for monitoring and reporting on the preparation and implementation of ESMP and ESIA throughout the sub-project duration. S/He will supervise and review environmental and social safeguard compliance. S/He will specifically be monitoring of the following aspects:

- The environmental and social assessment processes (screening; ESMP/ESIA preparation);
- The monitoring of the implementation of the mitigationmeasures;
- Monitoring of environmental and social issues and the supervision of the contractor civil works during the constructionprocess;
- Monitoring of environmental and social issues during operations and maintenance using the environmental indicators indicated in theESMP;
- Supervision of the implementation of theESMP

- Submission of monitoring reports to the Project CoordinationUnit

Quarterly and annual environmental and social safeguard performance reports should be prepared. The objective of the report should provide clear information about the activities carried out so as to the environmental and social safeguards requirements of the project. This report will be submitted to the project coordination team and to the World Bank country office.

Besides, annual reviews of implementation of the ESMP will be conducted. The annual reviews are intended improve procedures and capacity for safeguards compliance Annual reviews should be undertaken after the annual ESMP report has been prepared and before Bank supervision of the Project, at the closing of each year of the project.

Annual review workshops will be conducted at with the objectives to:

- Assess project performance in complying with ESMP & ESMF procedures, learn lessons, and improve future performance;and
- Assess the occurrence of, and potential for, cumulative impacts due to the proposed project and other development activities in the projectarea.

The participants of the ESMP review workshop are project implementing agencies whose project have environmental and social concerns and are responsible for the ESMP implementation at all levels. Besides, the World Bank, as necessary, will periodically conduct reviews of the implementation of the ESMP.

Table 11: Environmental and social risks mitigation measures implementation and Monitoring Plan

Impact and Mitigation/Enhancement commitments	Desired Outcomes	Monitoring Indicator	Frequency of monitoring	Responsibility/ Institution to monitor	Estimated Costs(USD)	Capacity Building & Training Requirements
Negative impact						
Impact of construction and demolition waste						
Impacts on Historical and Cultural Sites and Goods	Implementation of Chance Find Procedure and training of the construction workers	Chance Find Procedure implemented and all workers trained	Regularly during construction	Contractor, EFDA		Required
	Report chance finds immediately to Addis Ababa City Administration,, Department of Museums and Monuments .	All chance finds reported to AA City Administration Museum and Monuments department				
Wastes will be properly segregated and separated to encourage recycling	Records of proper waste disposal indicating quantities dumped and location of dumping site. Amount of waste disposed minimized by reuse	Proportion of construction and demolition of waste dumped in designated area (Target 100%) Percent of wastes recycled/reuse (At least	Quarterly	AAEPA ESD/MoH	300.00	None

Impact and Mitigation/Enhancement commitments	Desired Outcomes	Monitoring Indicator	Frequency of monitoring	Responsibility/ Institution to monitor	Estimated Costs(USD)	Capacity Building & Training Requirements
		20% of demolition and construction wastes)				
Wastewillbepickedoffthesiteeverydayandif not it will be covered to minimize nuisanceodorandvermin.	Hazardous wasteseparatedfrom non-hazardous wasteon site and each wastestream disposed ofaccording to EthiopianHCWMrequirementsin designatedsites	Presence of color coded/labeled container for segregation of hazardous and non-hazardous wastes Number oftimesawastepickedperday	Daily	AAEPA ESD/MoH	3000.00	None
Impactsfromphysicalhazards						
Ensuringsafeworkpractices afterorientationhasbeengiven	Occupationalsafetywillbemain tained	Proportion of workers who participated in orientation training (at least 95% of the workers should take the orientation)	Biannually	AAEPA	100.00	Required
Training and awareness creation on incidencehandling,preventionandpotentialem ergency	Maintains minimum workhazards	Proportion of workers who got training on incidencehandling,preventio nandpotentialemergency Documentationofrecordsoftr	Biannually	ESD	200.00	Required

Impact and Mitigation/Enhancement commitments	Desired Outcomes	Monitoring Indicator	Frequency of monitoring	Responsibility/ Institution to monitor	Estimated Costs(USD)	Capacity Building & Training Requirements
		ainingand Impromptu interviewswithworkerson occupationhealthsafety emergencyresponse				
Useofsignagetowarnstaffand/orvisitorsthatare not involved in construction activities ofdangerousplaces	Minimize occupationhealth safety risk onconstruction workers andthepublic	Availability of appropriatesafetysignageon-site	biannually	contractors	200.00	None
Safety supervision of works would be doneregularlytoensurethatsafetyconditionsaremetwhileanydeviationfromsafety regulations is immediately reclaimed following the bestpracticesregardingsafetyatworkequipment	Ensuresthatsafetyconditions aremeet	Presenceofsafetysupervisor on-site	daily	Contractor	to beincluded inthe constructor' cost	None
Developevacuationprocedurestohandle emergencysituations	Minimizeoccupation health and safety risk onconstructionworkers	Presence of documentedEmergency ResponsePreparednessPlan(ERPP)	pre-construction	contractor	100.00	None
Provideappropriatepersonnelprotectiveequipment(PPE)toallworkers	Minimize occupationhealth and safety risk onconstructionworkers	Proportion of workers wearing appropriate PPE	daily	Contractor	to beestimated & included inthebillof	None

Impact and Mitigation/Enhancement commitments	Desired Outcomes	Monitoring Indicator	Frequency of monitoring	Responsibility/ Institution to monitor	Estimated Costs(USD)	Capacity Building & Training Requirements
					quantities BOQ)	
Impactfromelectricalandexplosivehazards						
Allelectricalinstallationsandequipmentwouldbe inspected and tested regularly includingearthing/groundsystems	Minimize occupationhealth and safety risk onconstructionworkers	Record of electricalinstallations andequipmentinspectedand tested	Construction phase	ESD	to be includedin furnishingBOQ	None
Specialized refrigerators would be used whenstoringchemicalsthathaveexplosionpotential	Minimize occupationhealth and safety risk onconstructionworkers	Record of explosive chemical stored in a specialized refrigerator consistently	Construction phase	ESD	to be includedin furnishingBOQ	None
Impactfromtrafficaccidents						
Ensure drivers respect traffic laws and obeyspeedlimits	Noroadaccidentbyprojecttraffic	Number of accidentoccursineachmonthof constructionduration(Should be zero)	Construction phase	ESD	200.00	None
Ensurethatvehiclesareregularlymaintainedto minimizepotentiallyseriousaccidents	Noroadaccidentdueto poor mechanicalconditionsofprojectvehicles	Number ofaccidentoccursin each month ofconstructionduration (Should be nil)	Construction phase	ESD	Includedin theoverallconstructioncost	None

Impact and Mitigation/Enhancement commitments	Desired Outcomes	Monitoring Indicator	Frequency of monitoring	Responsibility/ Institution to monitor	Estimated Costs(USD)	Capacity Building & Training Requirements
Employsafe traffic controlmeasures,including temporary road signs , flag persons to warn ofdangerousconditionsandchildrencrossings,	Noroadaccidentbyprojecttraffic	Number ofaccidentoccursin each month of construction duration (Should be nil)	Construction phase	ESD	100.00	Required
Impacton airquality					**850.00**	
Dustscreensornetsinwindows,doorwaysand ventilatorwillbedeployedwheredemolitionoroth erdustyconstructionactivitiesareoccurring	Noexcessivedust emissions noted outsideconstructionareas	Number of complaints received due to excessive dust fromconstructionareas (Zero complaint recommended)	Construction phase	AAEPAESD Contractors	100.00	None
Ensuregood housekeepingandclean construction operations where, among othernecessaryactions,dustwouldbequicklyswe ptoff cement floors and collected in coveredcontainers	Minimizedustand exhaustemissions	Cleaned operation area including cement floor to minimize dust (in M^2) (Target: all working area should be cleaned regularly) Nocomplaints of trucks reckless driving fromcommunities along roadsusedbyprojectvehicles	Construction phase	AAEPA ESD contractors	100.00	None
Tominimize indoor dust, portable extractionsystems, water sprays or other	Minimizedustlevels	Number of activities conducted by the contractor	Construction phase	AAEPAESD contractors	100.00	None

Impact and Mitigation/Enhancement commitments	Desired Outcomes	Monitoring Indicator	Frequency of monitoring	Responsibility/ Institution to monitor	Estimated Costs(USD)	Capacity Building & Training Requirements
practical methodsareapplied		to minimize dust nuisance per day				
Truckswouldbecoveredduringhaulageof construction materials and would be divertedawayfromsensitiveareasoftheinstitute	No material spills on roadsduringhaulagetosites	Number of waste trucks properly load and covered with sheet to prevent spill during transport	Construction phase	AAEPAESD contractors	250.00	None
Impactofnoise andvibrations					**300.00**	
Construction workers will be aware of thesensitivenatureofworkplacestheyareoperating in and advised to limit verbal noise orother forms of noise. For example, metallicobjects or tools can be passed on to a colleagueratherthandroppingorthrowingthemwithloud bangs	Noexcessivenoisefromworkers	Number of complaints received due to noise during construction Proportion of days with above the maximum recommended level of noise (in db).	Construction phase	AAEPAESD contractors	Budgetincluded inprojectcost	TrainingRequired
All heavy duty immovable equipment will befitted with mufflers or placed in enclosures tominimizedisruptingambientnoiselevels	Construction activitiesgenerate permissible levelsofnoise	Proportion of heavy duty immovable equipment fitted with mufflers or place in enclosures	Construction phase	AAEPAESDMoLSA	100.00	None

Impact and Mitigation/Enhancement commitments	Desired Outcomes	Monitoring Indicator	Frequency of monitoring	Responsibility/ Institution to monitor	Estimated Costs(USD)	Capacity Building & Training Requirements
Contractor will ensure that equipment isproperlymaintainedandfittedwithmufflers	Construction activitiesgenerate permissible levelsofnoise	Number of equipment properly maintained and fitted with mufflers	Construction phase	AAEPA, ESD, MoLSA	Will beincluded intheoverall construction cost	None
Where possible, contractors would cordon offareas under construction with noise absorbingmaterials, for example, plywood rather than ironsheets	Keepsnoiseleveldown	Utilization of ply wood or other noise absorbing materials for cordon off areas under construction	Construction phase	AAEPA, ESD, MoLSA	Will beincluded intheoverall constructionc ost	None
Contractorensures noiselevelsemanatingfrom machinery,vehiclesandnoisyconstructionac tivitiesarekeptataminimum	Safety,healthand protection of people in thenearbybuildings	Proportion of days in which noise level below the maximum recommended is recorded Number of complain received from patients, visitors and staffs about noise during construction	Construction phase	AAEPA, ESD, MoLSA	-	None
Child labor and GBV/SEA/SH						

Impact and Mitigation/Enhancement commitments	Desired Outcomes	Monitoring Indicator	Frequency of monitoring	Responsibility/ Institution to monitor	Estimated Costs(USD)	Capacity Building & Training Requirements
	No risk of child labour or SEA/SH	- Number of training session provided to staff on GBV/SH and CoC. - Number of workers violation CoC - Number of CoC-violating workers and action taken - Proportion of workers recruited according to national labour law. - Number of child abuse or sexual offense practices reported to police office	Construction Phase Monthly Weekly	Contractor/ Supervision Consultant	Budgetincluded inprojectcost	
Grievances Redress Mechanism	Implement and communicate an accessible grievance mechanism for PAP to address any complaints	All grievances adequately treated through inspection of grievance log book and interviews with PAP	Regularly during construction & Operation	Contractor EFDA	Budgetincluded inprojectcost	Required
Impactsfromphysicalhazards						

Impact and Mitigation/Enhancement commitments	Desired Outcomes	Monitoring Indicator	Frequency of monitoring	Responsibility/ Institution to monitor	Estimated Costs(USD)	Capacity Building & Training Requirements
AllworkerstobeprovidedwithappropriatePPEagainst exposure to infectious pathogens,hazardous chemicals and ionizing radiation inaccordance with recognized international safetystandardsandguidelines.	Minimalwork-relatedinjuriesorinfections	Number of healthcare staff wear appropriate PPE according to IPC practices	Daily	EFDA safety officers & respective lab head	600.00	None
Orientation for all staff would be given on safework practices and guidelines and ensure thatthey adhere to it. Trainingwould be conductedon incident handling and prevent manage.Thiswould involveproper handling of electricity,water etc. and sensitization on various modes ofescape, conduct and responsibility during suchincidences.	Minimize occupationhealthsafetyriskonstaff	Number of staff oriented on safetypracticesand guidelines	Throughout laboratory operation	EFDA safety officers & respective lab head	1000.00	Safetypractices andguidelines
Regular drills would constantly follow onvarious possible incidences. This will test theresponse of the involved stakeholders. Suchdrillswillkeepthemalertandtheywillbecome more responsive tointhecaseofincidences	Staff preparedness to combatpossibleincidences	Number of drills conducted Recordsofincidenceprevented	Throughout laboratory operation	EFDA safety officers & respective lab head	-	None

Impact and Mitigation/Enhancement commitments	Desired Outcomes	Monitoring Indicator	Frequency of monitoring	Responsibility/ Institution to monitor	Estimated Costs(USD)	Capacity Building & Training Requirements
Usesignagetowarnstaffand/orvisitorsthatare not involved in laboratory work ofdangerousplaces	Publicandotherstaffsafety	Presence of appropriate andclear signage in and around laboratoryfacility	Throughoutlaboratoryoperation	EFDA safetyofficers &respectivelab head	200.00	None
Impactfromelectricalandexplosivehazards						
Allelectricalinstallationsandequipmentwouldbe inspectedandtestedregularly	Inspectedandtestedelectricalinstallationsandequipment	Record of electricalinstallationsandequipmentinspectedandtested	Operationphase(daily)	EFDA	-	None
Alllaboratoryelectricalequipmentwouldbeearthed/grounded	All electrical equipmentearthed/grounded	Record ofelectricalequipmentearthed/grounded	Operationphase	EFDA	-	None
Disconnect equipment attached to high-voltageorhigh-amperagepowersources	Disconnected equipmentattached to high-voltage oramperagepowersources	No.ofequipmentattachedtohigh-voltageor amperagepowersourcesconnected	Operationphase(daily)	EFDA	-	None
Flammableliquidswillnotbeplacedina householdrefrigerator	Householdrefrigeratorfree offlammableliquids	Flammableliquidsina householdrefrigeratorplaced	Operation phase(daily)	EFDA	-	None
Impactfromchemicalhazard						
Replacementofthehazardoussubstancewithalesshazardoussubstitute	Lesshazardoussubstance substitute	Number of hazardous materials substituted with less hazardous materials Lesshazardoussubstance	Operation phase (daily)	EFDA	-	None

Impact and Mitigation/Enhancement commitments	Desired Outcomes	Monitoring Indicator	Frequency of monitoring	Responsibility/ Institution to monitor	Estimated Costs(USD)	Capacity Building & Training Requirements
		substituteutilized				
Trainingworkersintheuseoftheavailableinformation(suchasMSDSs),safework practices,andappropriateuse ofPPE	SafeworkpracticesandPPE	Number of trained personnel	Operationphase (biannually)	EFDA	-	Yes
Impactof escapingofinfectiousagentsfromVaccine lab						
Personnel working in vaccine labwouldbetrainedonsampleandwastehandling ,transportation,andstorage	Personnel working invaccine trained onsampleandwastehandling,transportation,andstorage	Number of personneltrained on sample andwaste handling, transportation, & storage	biannually	FMOH,EFDA	1500.00	Yes
Equipmentwouldbemaintainedandcalibrated periodically	Equipmentmaintained and calibratedperiodically	CertificateofEquipment maintainedandcalibratedperiodically	Yearly	EFDA		None
BSCs HEPA filters would be tested annuallyandreplacedasnecessary.	HEPAfiltersmaintainedandcalibratedperiodically	Certificate ofHEPAfilters maintained andcalibratedperiodically	Yearly	EFDA		None
Effective vaccinesortherapeutic measures wouldbeavailableforallriskgroups	Vaccinateallstaffsintheriskgroups	Number of vaccinated staffsintheriskgroups	Yearly	EFDA		None

Impact and Mitigation/Enhancement commitments	Desired Outcomes	Monitoring Indicator	Frequency of monitoring	Responsibility/ Institution to monitor	Estimated Costs(USD)	Capacity Building & Training Requirements
All material would be sterilized by autoclave orchemicaldisinfection	Disinfectionofcontaminatedmaterials	Observingroutinedisinfectionactivities are inplace	daily	EFDA		None
Vaccine lab would be lockedalways and access restricted for non-authorizedpersonnel	Implementing accesscontrolmeasuresinthefacilities	Observingallappropriateaccess control measures areinplace	daily	EFDA		None
Potentialimpactsassociatedwithoperationof Vaccine lab						
All procedures involving the manipulation ofinfectious materials would be conducted withinBSCsorotherphysicalcontainmentdevicesand	All infectiousmaterialsprocessed withinBSCs orothercontainments	Observation to ensureinfectious materialsprocessing	during theentire operation phase	EFDA	cost to beincluded in theconstruction cost	No
Personnelworkingin vaccine labwould receive specific training in handlingpathogenic and potentially lethal agents andwould be supervised by competent staff inhandling infectious agents and associatedprocedures	Personnel working invaccine labtrainedon sample and wastehandling,transportation,and storage	Number of personnelworking in vaccine lab trained on sampleand wastehandling,transportation, andstorage	biannually	EFDA	1500	No
ImpactofhandlingofstorageofinfectiousmaterialsandspecimentheproposedVaccine Lab						
Userobustandleak-proof specimencontainers	Robust andleak-proofspecimen containersused	Availableofrobustandleak-proof specimencontainersused	operation phase	EFDA	to beincluded inthematerials procurementcost	None
Containerswouldbecorrectlylabelledtofacilitatei	Properlabellingofallthecontai	Observationtoensureproperla	operationpha	EFDA		None

Impact and Mitigation/Enhancement commitments	Desired Outcomes	Monitoring Indicator	Frequency of monitoring	Responsibility/ Institution to monitor	Estimated Costs(USD)	Capacity Building & Training Requirements
dentification	ners	bellingisinplace	se			
Specimen request or specification forms wouldnot be wrapped around the containers but placedinseparate,preferablywaterproofenvelopes	Appropriatespecimenhandling	Observationto ensurespecimenhandlingsystemisinplace	operationphase	EFDA	costwillbeincludedin furnishingcosts	None
Secondarycontainers,suchasboxes,wouldbeused, fitted with racks so that the specimencontainersremainupright.	Avoidaccidentalleakageor spillage fromspecimens	NumberofrecordedSample spills andleakagesoccurred	operationphase	EFDA	costwillbeincluded infurnishing costs	None
ImpactassociatedwiththeuseofequipmentintheVaccine Lab						
Trainingofworkersinequipmentoperatingandhandlingtechniquesduringoperation	Personnelworkingin Vaccine labtrainedon sample and wastehandling,transportation,and storage	Numberofpersonnel working in Vaccine lab trained on sampleand wastehandling,transportation, and storage	biannually	EFDA	1500	Yes
Periodic maintenance and calibration ofequipment according to manufacturerecommendation.	Equipment maintainedandcalibratedperiodically	Certificate of Equipmentmaintained and calibratedperiodically	Yearly	EFDA	3000	None
Operationof equipmentaccordingtothemanufacturer'sinstruct	Equipmentoperatedaccordingtothe	Equipmentmanufacturer's instructions using	daily	EFDA	-	None

Impact and Mitigation/Enhancement commitments	Desired Outcomes	Monitoring Indicator	Frequency of monitoring	Responsibility/ Institution to monitor	Estimated Costs(USD)	Capacity Building & Training Requirements
ions	manufacturer'sinstructions	tooperateequipment				
Impactof contaminationoftheVaccine lab						
Workerswouldbetrainedonevacuationofthecontaminatedareaandondecontaminationor disinfection	Trained staff onevacuationofthe contaminatedarea	Numberofstafftrainedonevacuationofthe contaminatedarea	biannually	EFDA	1500	Yes
Rinsing,andwipingdryofthespillageareawith an absorbent cloth by personnel wearingadequateprotectiveclothing	wipingofspillagearea	Numberofstafftrainedonwipingofspillagearea	daily	EFDA		Yes
Decontamination or disinfection of theprotectiveclothingifnecessary	Decontamination ordisinfectionofthe protectiveclothing	Numberofstafftrainedondecontaminationor disinfectionofthe protectiveclothing	daily	EFDA		Yes
Handlingandmanagingofspillandsplash	Handlingandmanagingofspillandsplash	Numberofstafftrainedonhandling and managing of spill andsplash	daily	EFDA		Yes
Potentialimpactduringtheoperationofwarehouse						
Implementationofengineeringand administrativecontrolmeasures	Authorizedpersonnelonly	Numberofstaffauthorized	Operation phase	MOH, EFDA	-	None
Storechemicalsinawell-ventilatedarea,donot storechemicalsinafumehood	Properlystoredchemicals	Numberandtypeofproperlystoredchemicals	Operation phase	MOH, EFDA	-	None

Impact and Mitigation/Enhancement commitments	Desired Outcomes	Monitoring Indicator	Frequency of monitoring	Responsibility/ Institution to monitor	Estimated Costs(USD)	Capacity Building & Training Requirements
ProvidetrainingintheuseofMSDSs,safework practicesand appropriateuseofPPE	Advocatesappropriatehandlingofchemicals	Numberoftrainedstaff	Operation phase	MOH, EFDA	100.00	Yes
Maintainaninventoryofallchemicals	Type and numberofchemicalsusedandleft	Numberofchemicalsstored	Operation phase	MOH, EFDA	-	None
Impactoffireoutbreak						
Allstaffwillhavetraininginfirecontrol	Declinestheriskoffire hazard	Numberoftrainedstaff	Operation phase	MOH, EFDA	500.00	Yes
Fire extinguishers would be available inaccessible area and ensure that all fire-fightingequipmentisregularlymaintainedandserviced.	Facilitieshasbasiccapacitytofendoffasmalloraveragefireoutbreak	Availability of fire extinguisher in all risk area of vaccine lab building	Duringequipmentinstallation,uponcompletionof construction	MOH, EFDA	Negligible	None
Fireemergencytelephonenumberswouldbe displayedincommunalareas.	Contactfiredepartment incaseofmajorfireoutbreak	Number of communal area in which fireemergencytelephone numbersdisplaced	Operation phase of labandstore facility	MOH, EFDA	Negligible	None
Automaticfirealarmsystemfor theentirelaboratorywillbeinstalled	Facilitieshasbasiccapacity to fend off a smalleroraveragefireoutbreak	Presence of automaticfirealarmsystem,adequatewater hose reel and reversewatertank	Operationphaseoflab andstoreface ility	MOH, EFDA	Included intheoverall constructioncost	None
Firehazardsignssuchas‘NoSmoking’ signs	Facilitieswillhavehazard	Number ofsignsprovided	Operation	MOH, EFDA	Negligible	None

Impact and Mitigation/Enhancement commitments	Desired Outcomes	Monitoring Indicator	Frequency of monitoring	Responsibility/ Institution to monitor	Estimated Costs(USD)	Capacity Building & Training Requirements
willbeprovided	signs		phase			
Directionstoexit incaseofanyfireincidenceand emergency contact numbers will beprovided	Facilitieshasbasiccapacity to fend off a smalleroraveragefireoutbreak	Presence of automaticfire alarmsystem,adequate water hose reel and reversewatertank	Operationphas eoflab andstore facility	MOH, EFDA	100.00	None
Contact/emergency numbers will be displayedwithinthelaboratory.	facilities hascapacitytocontactfiredepartm entin case of major fireoutbreak	Presence of fireemergencytelephone numbers displaced within the facilities	Throughouto peration lifeof facilities andstore facility	MOH, EFDA	Included inthe overallcost	None
Trainingofworkersinliftingandmaterialshandling techniquesduringoperation	Makeuseofmaterialhandlingtec hniquesduringoperation	Numberoftrainedworkers	Operationp hase	MOH, EFDA	1000.00	Yes
Planningworksitelayout	Minimizetheneedfor manualtransferofheavyloads	Identifiedlayouts	Operationp hase	MOH, EFDA	-	None
Selectingtoolsanddesigningworkstations	Reduce forcerequirementsandholding times	Toolsusedandworkstationsdes igned	Operationp hase	MOH, EFDA	-	None
Impactofairpollutionduetowasteincineration						
Wastesegregationforwasteswith polychlorinatedwouldbedoneandthesewastewo uldneverbeincinerated	Wastewith polychlorinated dibenzo-dioxinsand polychlorinated	Provision wastewith polychlorinated dibenzo-dioxinsand polychlorinated	Operation phase	EFDA	25.00	None

Impact and Mitigation/Enhancement commitments	Desired Outcomes	Monitoring Indicator	Frequency of monitoring	Responsibility/ Institution to monitor	Estimated Costs(USD)	Capacity Building & Training Requirements
	dibenzo-furansPCDD/Fs segregated and notincinerated	dibenzo-furansPCDD/Fs disposedwithoutincinerating				
WorkerswillbeprovidedwithPPEandtheuse ofPPEwouldbeenforced	AvailableofadequatePPEandutilizingofPPE	Number of staffutilizingofPPE	Operation phase	EFDA	25.00	Yes
Improveincineratorsandinfrastructurefor healthcarewastetreatmentanddisposal	ImplementedWB& WHO wastetreatmentanddisposalrequirements	Acceptablewaste treatment and disposalsystemimplemented	Operation phase	EFDA	25.00	None
Maintainthenewincineratorstobeinstalledperiodically	Periodically maintainedincinerators	Frequencyofperiodicallymaintainedincinerators	Operationphase	EFDA	2000	None
Purchasenewenvironmentalfriendlyincinerator	A new environment friendlyPyrolyticincinerator purchased&installed	Presence of functionalenvironmentfriendly Pyrolyticincinerator	Operationphase	EFDA	Thiscostwill beincluded intheprojectimplementation oncost	None
Misuseand/or theft of infectious agents and laboratory equipment/supplies in the facilities						
StrictBiosecuritymeasureswouldbeimplemented	Limitsaccesstofacilities, researchmaterialsandinformation	Accesslimited	Operationphase(daily)	EFDA	-	None
Continuetheuseofdigitalinventorysystemfor boththemicroorganismsandequipment	Inventoryofequipmentandorganisms	Number of inventories conducted in the facility	Operation phase(daily)	EFDA	-	None

Impact and Mitigation/Enhancement commitments	Desired Outcomes	Monitoring Indicator	Frequency of monitoring	Responsibility/ Institution to monitor	Estimated Costs(USD)	Capacity Building & Training Requirements
Develop measures to protect against the insiderthreat (employees, staff, or contractors), oroutsiderthreat(outsiderswhointendtogain accesstodoharm) andanynatural or manmadeevents	Defines security and biosecurityinthecontextofthelab	Legalproceduresdeveloped Implementation of Ethiopian selected hazardous pathogen and toxin (ESHPT) proclamation	Operationphase(daily)	EFDA	-	None
Establish system for physical security, personnelsecurity,materialcontrol&accountability,and informationsecurity	Developsecuritypracticesandcommunication	System established forphysical,personnelandmaterialcontrol	Operationphase(daily)	EFDA	1500	,None
Allstaffwillhavetraininginlaboratorysecurity andbiosecurity	Understandingandpracticing securityissues	Numberofstafftrained	Operation phase	EFDA	1000.00	Yes
The vaccine labwouldalwaysbelockedandnon-authorized personnelforbiddentoenterthefacilitieswithoutpermission.	Restrictsaccesstofacilities	Number ofcontrolledgatesanddoors	Operationphase	EFDA	-	None
Genderbasedviolenceimpacts						
Conduct continued sensitization and awarenessraisingtoEFDAstaffonpreventionofGBV	Awarenesscreation	Numberofstafftrained	Continuedsensitization	EFDA	100.00	Yes
StrengthentheGenderandwomen toaddressGBVcaseswhenitoccurs	StrengthenedofficeofGBV	Amount of technical and materials support given to the	Whenever necessary	EFDA	100.00	Yes

Impact and Mitigation/Enhancement commitments	Desired Outcomes	Monitoring Indicator	Frequency of monitoring	Responsibility/ Institution to monitor	Estimated Costs(USD)	Capacity Building & Training Requirements
		Gender and Women office at EFDA				
Risksassociatedwithwastetransportationwithinthe lab Compound						
Allwastebagswouldin-placeandintactatthe endof transportation	Designatedpathwaysforwaste transportation	Availableroutesinplace	daily	EFDA	1000	None
Carts, trolley, or containers, used for thetransportation of infectious waste would not beusedfor thetransportationof anyother material	Haveseparatedtrolley&cartsfor sharps,infectious& infectiouswaste transportation	Availability of color-codedCarts, trolley or containers foreachtypeofwastes	daily	EFDA	-	None
Wastebagswouldbeplacedincontainers(e.g.cardboard boxes or wheeled, rigid, lidded plasticorgalvanizedbins),beforebeingplaced directly intothetransportationvehicle	Maintainedsecondarycontainment	Presenceofappropriatesecondarybarrier	daily	EFDA	-	Yes
Thecollectedwastewillnotbeleftevent temporarilyanywhereotherthanatthede signatedstorageroom	Wastes stored onlyatdesignatedstorageare a	Presenceofwastesotherth andesignatedplace	daily	EFDA	-	None
Containerswouldbecoveredwithlidsduringsto rageandtransport.	Waste storage andtransportation	Availabilityofwastestorageand transportationbinwith lid	daily	EFDA	-	None
Transportstaffwouldwear adequatepersonal protectiveequipment(PPE)	RegularuseofPPEby wastetransportstaff	Proportion of waste collectors	daily	EFDA	-	None

Impact and Mitigation/Enhancement commitments	Desired Outcomes	Monitoring Indicator	Frequency of monitoring	Responsibility/ Institution to monitor	Estimated Costs(USD)	Capacity Building & Training Requirements
		wear appropriate PPE				
Educationandtrainingwouldbeprovidedtoall wastetransportworkers	Trainedwastehandlers	Numberoftrainedwastehandlers	biannually	EFDA	1500	None
Abulkyandheavywastewouldbetransportedby using wheeled trolleys or carts that are notusedforanyotherpurpose	A bulky and heavy wastewould be transported byusingwheeledtrolleys or carts that are not used foranyotherpurpose	Transportation of bulky and heavy wastes by wheeled trolleys in place	daily	EFDA	-	None
Waste,especiallyhazardouswaste,wouldneverbe transported by hand due to the risk ofaccidentorinjuryfrominfectiousmaterial	Waste, especiallyhazardous waste, wouldnever be transported byhanddue to the risk ofaccidentorinjuryfrom infectious material	Number of persons injured by infectiousmaterials	daily	EFDA	-	None
Thevehicleswouldbethoroughlycleanedanddis infecteddailyasperawrittenprotocol	Thevehicleswouldbethoroughlycleaned& disinfecteddailyasperawrittenprotocol	Proportion of vehicles cleananddisinfecteddaily	dialy	EFDA	250.00	None
Riskassociatedwithoff-sitetransportofwaste						
EFDA would follow applicable national regulations and internationally accepted	Standardized transport of Hazardous materials and	Availability of standardized hazardous materials transport	Throughout theoperation	AAEPA,EFDA		None

Impact and Mitigation/Enhancement commitments	Desired Outcomes	Monitoring Indicator	Frequency of monitoring	Responsibility/ Institution to monitor	Estimated Costs(USD)	Capacity Building & Training Requirements
standards for packaging, labeling, and transport of hazardous materials and wastes	wastes	system in place				
The vaccine lab would use tanks and containers specially designed and manufactured	Tanks will be appropriate for the wastes they are intended to carry	Availability of acceptabletanks for wastewater invaccine lab premise	Throughoutt heoperation	AAEPA,EFDA	Tobeincluded infurnishing cost	None
The vaccine lab would adequately label all transport tanks andcontainers	Identifies the contents, hazards, and actions required in various emergency situations.	Proportion of waste transport tanks and container with labeling	Operation phase	AAEPA,EFDA	-	None
Containers would be covered with lids during transportation	Containers covered with lid	Number of containerswith lid	Operation phase	AAEPA,EFDA	-	None
Vehicles used for transporting infectious wastewould be disinfected prior to use for any otherpurpose	Disinfected vehicles	Number of vehiclesdisinfected	Operationphase	AAEPA,EFDA	-	None
Vehicles shall carry adequate supplies of plasticbags, protective clothing, cleaning tools, anddisinfectants	Minimizes hazard through cleaning and disinfection in case of any spills	Amountofcleaningsupplies	Operationphase	AAEPA,EFDA	-	None
Records must be kept documenting all transport Of medical waste	Recorded transported wastes	Record of transported wastes	Operation phase	EFDA	-	None
Riskassociatedwithsolidwastetreatmentatthe compound						

Impact and Mitigation/Enhancement commitments	Desired Outcomes	Monitoring Indicator	Frequency of monitoring	Responsibility/ Institution to monitor	Estimated Costs(USD)	Capacity Building & Training Requirements
Waste segregation for wastes with polychlorinated dibenzo-dioxins & polychlorinated dibenzo-furans PCDD/Fs would be done and these waste would never be incinerated	Segregated waste withpolychlorinated dibenzo-furansPCDD/Fs	Presence of Waste segregation system	Operationphase	MOH, EFDA	-	None
Materials free of polychlorinated dibenzo-dioxins and polychlorinated dibenzo-furans PCDD/Fs would be purchased, for minimizing the environmental and health impacts.	Purchasedmaterialsfreeof polychlorinateddibenzo-dioxins andpolychlorinated dibenzo-furansPCDD/Fs	Proportion of purchased materials free of polychlorinated dibenzo-dioxins and polychlorinated dibenzo-furansPCDD/Fs	Operationphase	MOH, EFDA	-	None
Impactassociatedwithfinaldisposal ofsolidandliquidwastes						
Personnel working on waste disposable would wear adequate personal protective equipment (PPE)	Reducedexposuretowastes	Availability of adequate PPE per workers Proportion of workers wearing appropriate PPE regularly	Operationphase	AAEPA,EFDA	-	None
Training would be provided to personnel working on waste disposable	Defines the concept of wastedisposalandsafety	Numberofstafftrained	Operationphase	AAEPA,EFDA	1000.00	Yes
Bottomashwouldbemanagedseparatelyfromflyashandotherfluegastreatment	Avoidcontaminationofthebottomashforits potentialrecovery	Amount of bottom ashmanaged	Operationphase	AAEPA,EFDA	-	None

Impact and Mitigation/Enhancement commitments	Desired Outcomes	Monitoring Indicator	Frequency of monitoring	Responsibility/ Institution to monitor	Estimated Costs(USD)	Capacity Building & Training Requirements
Bottom ash would be treated on-site by Screening and crushing to the extent that is required to meet the specifications set for its use or at the receiving treatment or disposal site	Helps achieve a leaching Level for metals & salts that is in compliance with the local environmental conditions at the place ofuse	Amount of bottom ashtreated	Operation phase	AAEPA,EFDA	-	None
Bottomashandresidualswouldbemanagedbasedontheirclassificationashazardousor non-hazardousmaterials	Classifiedbottom ashes	Segregation of bottom ash and residuals in place	Quarterly	AAEPA,EFDA	-	None
Predominantly hazardous wastes would be disposed of in safe landfills, and the land filling would be in proper double-walled containers	Safe landfill disposal	Proportion of hazardous wastes disposed in safe landfill	Quarterly	AAEPA,EFDA	1000	None
Waste disposal system would be monitored periodically	Identified technical problems and technology updates	Number of monitoring conducted	Quarterly	AAEPA,EFDA	2000.00	None
Incinerators ofwastewatertreatmentsystem management	Identified any pollution from fly ash and flue gas	Recordofemissionfrom incineratorperiodicalmonitored Number of monitoring conducted on emission of incinerator	Quarterly	AAEPA,EFDA	1000.00	None

Impact and Mitigation/Enhancement commitments	Desired Outcomes	Monitoring Indicator	Frequency of monitoring	Responsibility/ Institution to monitor	Estimated Costs(USD)	Capacity Building & Training Requirements
The new incinerator would be monitoring for proper functionality periodically	identified any defect ormal function of incinerator	Number of monitoring conducted on functionality of incinerator Record of preventive maintenance of incinerator periodical monitored	Quarterly	AAEPA,EFDA	500.00	None
Totalcost			**38,275.00USD**			

For the effective implementation of the ESMP a regular and period follow up is required. The objective of this isto:

- Alert project authorities by providing timely information about the success or otherwise of the Environmental management plan outlined in this ESMP. This will ensure continuous improvement to environmental and social management process during the life cycle of theproject.
- Make a final evaluation in order to determine whether the mitigation measures incorporated in the technical designs and the ESMP have been successfullyimplemented.

Table 12: Laboratory Waste Management and Monitoring Plan

Mitigation measures	Responsible Authority for implementation	Responsible Authority for Monitoring	Recommended Frequency/times of Monitoring
Develop specifications and standards for waste management equipment and supplies	MoH/EFDA	EPA	One Draft and final Standards and Specification for each laboratories
Install pyrolysis incinerator with a capacity to burn 50 kg per hour with emission reduction device control (Fabric filter coated with catalyst) made from PTFE (This is planned to install with Vaccine Lab)	MoH/EFDA	EPA	Approved Standards and installed Incinerator
Purchase initial supplies for waste management	MoH/EFDA	EPA	Purchase requisitions, delivery notes and receipts
Purchase Occupational Health and Safety /Personal Protective Equipment.(PPEs)	MoH/EFDA	Once on making estimates and requisitions Once afterpurchase	Once on making estimates and requisitions Once afterpurchase
Procure and install water storagetanks	MoH/EFDA	-	Once on making Estimates and requisitions. Once after purchase - During construction
Develop and implement public (including indigenous people) social mobilization/ awareness	MoH/EFDA	-	Continuously during preparation of plans and during implementation
Ensure set-up of the facilities are conducive for easy and safe working	Laboratory Manager	EPA/MoLSA	Monthly
Availability of appropriate laboratory chemicals / materials to avoid or minimize waste	Laboratory Manager	MoH/EFDA	Monthly

Mitigation measures	Responsible Authority for implementation	Responsible Authority for Monitoring	Recommended Frequency/times of Monitoring
Minimize movement of people in the work area	Laboratory Manager	MoH/EFDA	All the time
Use colour coded waste bins in appropriatepositions	MoH/EFDA	EPA	Quarterly
Segregation and storage of waste into marked bins	Laboratory Manager	EPA	Monthly
Place disposable and re- usable materialsseparately	Laboratory Manager	MoH/EFDA	Monthly
Disinfect re-usable materials such as slide holders, forceps etc.	Laboratory Manager	MoH/EFDA	Monthly
Follow steps and times for waste movement, storage and internal transportation	Laboratory Manager	MoH/EFDA	Monthly
Sterilize or disinfect waste before it leaves the laboratory	Laboratory Manager	MoH/EFDA	Disinfections statistics, Inspection report
Discard contaminated materials and sputum containers in 5% phenol disinfectant or as recommended.	Laboratory Manager	MoH/EFDA	Number of disinfections done per day. Inspection report
Disinfect TB work surface areas with appropriate chemicals or methods.	Laboratory Manager	MoH/EFDA	Number of disinfections done per day
Ensure internal safe movement of covered carts/bins for waste	Laboratory Manager	MoH/EFDA MoH/EFDA	Quarterly
Ensure availability of staff Specifically designated for wastemovement	Laboratory Supervisor	MoH/EFDA MoH/EFDA	Monthly
Ensure availability and use of appropriate tools, protective wear and safety equipment	Laboratory Manager	MoH/EFDA	Quarterly
Tightly close and secure waste bins to avoid waste spills during transportation	Laboratory Supervisor	MoH/EFDA MoH/EFDA	Daily
Provide covered trucks for movement of waste to distant disposal site where necessary	Laboratory Manager	MoH/EFDA	Every six months
Follow defined routes of waste (loaded carts) movement	Laboratory Supervisor	MoH/EFDA	Daily
Ensure availability of washing and disinfecting material for staff	Laboratory Supervisor	MoH/EFDA	Daily

Mitigation measures	Responsible Authority for implementation	Responsible Authority for Monitoring	Recommended Frequency/times of Monitoring
Ensure availability and use of appropriate tools and PPE for personnel at disposal sites	Laboratory Manager	MoH/EFDA	Quarterly
Ensure appropriate method of treatment is used for each type of waste	Laboratory manager	MoH/EFDA	Monthly
Cover disposal pits when half full to prevent access by people, animals and birds.	Laboratory Supervisor	Laboratory Manager MoH/EFDA	As appropriate, just before pits are covered
Line disposal pits and provide under drains to prevent water pollution from leachate	Local municipal Authority	MoH/EFDA	Monthly
Install incinerators with air pollution treatment facilities		MoH/EFDA	Monthly
All year round accessibility to disposal site.	Local municipal Authority / local Env'tal protection offices	MoH//EFDA/EPA	Biannually
Location of disposal site to be: • Far from habitedareas • On a leewardside • Far from reach ofanimals • Low water tablesites	Local municipal Authority / local Environmental protection offices	MoH//EFDA/EPA	As necessary during disposal facility sighting
General Compliance			
Use of appropriate technology	MoH/EFDA	EPA	Quarterly
General health and safety of workers, employees and public	MoH/EFDA	EPA	Quarterly
Nuisance (air pollution, dust, smell and aesthetics	MoH/EFDA	EPA	Quarterly
Water pollution	MoH/EFDA	Ministry responsible for Water Resources EPA	Quarterly

9.CAPACITY DEVELOPMENTAND TRAINING

The development and operation of the proposed vaccine laboratory complex needs to have a strong Environment, Health and Safety monitoring and inspection capacity that will ensuring installation and observance of all safety features and protocols in the proposed project. In addition, capacity is needed to ensure monitoring of the ESMP implementation both during construction and operation phases of the proposedproject. At present it appears that both the EFDA and MOH/ESD directorate lacks a dedicated EHS unit ordedicated personnel responsible for planning and implementing EHS activities. Thus there is a need for capacitydevelopment by providing technical support and training in the areas of laboratory safety, workers and community safety, as well as in environmental monitoring for both the EFDA and MOH/ESD directorate.

The training in the areas of Vaccine laboratory safety, workers and community safety, as well as in environmental monitoring for implementation monitoring will be provided to relevant staff of MoH/ESD, EFDA, EPA and AABoLSA to enhance their skills in environmental monitoring during the operational phases of the proposed project services. The budget for technical support and capacity building training will be **65,000.00USD** (See Table 13).

Table 13: Trainings plan for Vaccine laboratory facility Staff and Supportive Staff

CapacityNeeds	TargetParticipant	Numberof participants	Estimated Cost(USD)
TrainingonInfection Prevention and control, and wastemanagement	• Professionals working in Vaccine laboratory facilities • Cleaners, waste transporters andhandlers, incinerator operators,liquid waste treatment facilityoperators andotherstaffofthe Vaccine laboratory facility	70 24	8,000.00

TrainingonOSHAand EnvironmentalSafety	• Wastewater treatment Plant Operator, Incinerator Operator, Waste handler, Laboratory Director, Laboratory scientist, Laboratory quality Manager \ Biosafety and biosecurity Officer and other pertinent staff	70	8,000.00
Training on Biosecurity	• Professionals working in Vaccine laboratory facilities, and building security person	24	8,000.00
Qualitymanagementsystem	• Professionals working in Vaccine laboratory facility	70	10,000.00
Specimensmanagement	• Professionals working in Vaccine laboratory f facility • Cleaners, waste transporters andhandlers, incinerator operators,liquid waste treatment facilityoperatorsandotherstaffofVaccine laboratory facility	70 24	8,000.00
Training on emergencypreparednes sandresponse	• Professionals working in Vaccine laboratory facility • Cleaners, waste transporters andhandlers, incinerator operators,liquid waste treatment facilityoperatorsandotherstaffoftheVaccine laboratory facility	70 24	8,000.00
Trainingonhandlingchemicals andpotentiallylethalagents	• ProfessionalworkinginVaccine laboratory facility	16	7,000.00
Training on use of MSDSs, safework practices, and appropriatePPE	• Professional working in Vaccine laboratory facilities • Cleaners, waste transporters andhandlers, incinerator operators,liquid waste treatment facilityoperatorsandotherstaffofVaccine laboratory facility	70 24	8,000.00
Total			**65,000.00**

For effective implementation of the ESIA/ESMP, technical assistance is also required to build the capacity and discharge their responsibilities as per the requirements. This assistance includes training on monitoring of the effective implementation of the mitigation

measures set out in the ESMP and in monitoring and supervision of the ESIA implementation to carry out on a bi-annual basis. The overall budget estimate for technical assistance (implementation and monitoring of ESMP) and capacity building and training for the implementation of ESIA (as indicated in the table 10, 11&13) is **$770,775.00**

10. CHANCE FINDS AND GRM PROCEDURE

10.1. Chance Finds Plan

Proclamation to Provide for Research and Conservation of Cultural Heritage (Proclamation No 209/2000) outline procedures for chance or fortuitous finds. It is outlined in Article 41 and states that: Any person who discovers any cultural heritage in the course of excavation connected with mining, explorations, building works, road construction or other similar activities shall report to the Authority and protect and keep same intact until the Authority takes delivery thereof. The Authority shall take all appropriate measures to examine, take delivery and register the Cultural heritage so discovered. Where the Authority fails to take appropriate measures within 6 months, the person that discovered the cultural heritage may be released from the responsibility by submitting a written notification with a full description of the situation to the Government official.

Scientific procedures to avoid damage to cultural property would include carrying consultations with the appropriate authorities and local inhabitants to identify known or possible sites during project planning. Construction procedure for dealing with "chance finds includes cessation of work until the significance of a "find" has been determined by the appropriate authorities and local inhabitants, and until fitting treatment of the site has been determined and carried out.

10.2. Grievance Redress Mechanism

GRM procedure

Despite the wide support for the Vaccine laboratory project in the community side, it is likely that there would be complaints by the neighborhood community in relation to construction activities, waste management (both construction & operational waste). There could also be complaints from unforeseen sources. This section describes the procedures, roles and responsibilities for addressing such grievances and resolving disputes. Every aggrieved person shall be able to trigger this mechanism to quickly resolve their complaints.

The objectives of the grievance process are:

- Ensure that appropriate and mutually acceptable corrective actions are identified and implemented to address complaints;
- Verify that complainers are satisfied with outcomes of corrective actions;

- Avoid the need to resort to judicial proceedings;

Possible sources of grievance in this case would be:

- Neighboring community, patients and health workers;
- Supervising engineers and contractor;
- Monitoring team who will forward issues/concerns identified in the field;
- Environmental advocacy groups

GRM during construction phase

During the construction phase of the proposed vaccine Laboratory, the proponent (MOH and EFDA) and the contractor will jointly set up a project specific GRM with a team comprising of construction supervisor, and delegated officers from the Bureau of Health who will receive and log, and address any disputes, conflicts or concerns arising from stakeholders that may be aggrieved by the project.

The grievance redress team will liaise with the contractor and proponent in developing the redress actions and communicate with the aggrieved stakeholders any resolutions made. Thereafter, the aggrieved stakeholders will be involved in monitoring and evaluation of the redress actions to access their effectiveness.

GRM during operation phase

During the operation phase of the laboratory, the grievance process steps outlined below is recommended to manage all the grievances. This GRM will have accountability mechanism for handling issues, disputes, and complaints. It will be accessible so that individuals, workers, communities, and/or civil society organizations that are being aggrieved by any activities of the project operation can use it.

Grievance process:

Step 1: Receipt of complaint

A verbal or written complaint from a complainant will be received by the head of the complaint hearing office and recorded in a complaints log. The log will indicate grievances, date lodged, action taken to address complaint or reasons the grievance was not acted on; information provided

to complainant and date the grievance was closed. Grievances should be lodged at work hours, directly to the complaint hearing office.

The process for lodging a complaint is outlined below:

- Complaint hearing officer receives complaint(s) from complainant and records it in log;
- Complaint hearing officer reads the recorded complaint to confirm correct detail of complaint has been documented;
- Complainant signs the log to confirm grievance was accurately recorded.

The head of the complaint hearing office will be the focal person for the GRM process and he/she will be the first point of contact to trigger the mechanism.

Step 2: Determination of corrective action

A grievance can be solved at this stage; the complaint hearing office will determine a corrective action in consultation with the aggrieved person. Remedial action(s) and timeframe within which they must be accomplished has been described and the party responsible for implementing them will be recorded in the complaint log. Grievances will be resolved and status reported back to complainants within a week. If more time is required this will be communicated clearly and in advance to the aggrieved person. For cases that are not resolved within the stipulated time, detailed investigations will be undertaken and results discussed not more than 1 month from lodging a grievance.

Step3: Meeting with the complainant

The proposed corrective action and the timeframe in which it is to be implemented will be discussed with the complainant within a week of receipt of the grievance. Maximum duration for the Consent to proceed with the corrective action will be sought from the complainant.

Step 4: Implementation of corrective action

Agreed corrective action will be undertaken by the project or its contractor within the agreed timeframe. The date of the completed action will be recorded in the log against the complainant's grievance.

Step 5: Verification of corrective action

To verify satisfaction, the aggrieved person will be asked to return if not satisfied with the corrective action.

Step6: Action by MOH/EFDA and project contractors

If the Work supervisor cannot solve the grievance, he will refer it to MOH/EFDA and contractor through the Supervising Engineer. It is believed all possible grievances can be solved at this level.

World Bank's Corporate Grievance Redress Service (GRS)

Communities and individuals who believe that they are adversely affected by a World Bank (WB) supported project may submit complaints to existing project-level grievance redress mechanisms or the WB's Grievance Redress Service (GRS). The GRS ensures that complaints received are promptly reviewed in order to address project-related concerns. Project affected communities and individuals may submit their complaint to the WB's independent Inspection Panel which determines whether harm occurred, or could occur, because of WB non-compliance with its policies and procedures. Complaints may be submitted at any time after concerns have been brought directly to the World Bank's attention, and Bank Management has been given an opportunity to respond. For information on how to submit complaints to the World Bank's corporate GrievanceRedress Service (GRS),

Please visit http://www.worldbank.org/en/projects-operations/products-and-services/grievance-redress-service. For information on how to submit complaints to the World Bank Inspection Panel, please visit www.inspectionpanel.org

11. ESIA REPORT DISCLOSURE AND CLEARANCE

From the outset, it is emphasized that the project involves a multitude of stakeholders including the Regional and Federal governments, EFDA/MOH the project owner through to financiers, NGOs, etc. Projects like this usually attract the attention of various stakeholders and hence are often prone to various scrutinies, including criticisms. This is especially true in today's highly globalized world. Therefore, it is important for the project to encourage views and comments from all players and address them properly and adequately regardless of their sources, types and motives.

EFDA/MOH as the project developer is responsible to provide all stakeholders at all levels with accurate and up-to-date information about this ESIA. Methods and modalities for public disclosure can take different forms depending on what is intended to be achieved. The bottom line, however, is the participation of all key players at all levels - local, regional, national as well as international ones.

The ESIA document will be submitted to the Ethiopian Environmental Protection Authority (EPA), for their review and approval.

This ESIA will be uploaded on MOH's website and WB external website as part of the public disclosure process.

This electronic medium will serve as a permanent promotion, information and public relations forum for the project making it easier to reach out to both national and international stakeholders and address their concerns, exchange views, experiences and information on matters related to the project.

References

- AACIB (2006). Strategic Plan of Addis Ababa City (1998-2003E.C.). Addis Ababa City Administration,Culture and Information Bureau: Addis Ababa.
- Beles Engineering, (2014) Environmental and Social Impact Assessment of the Wastewater Treatment Plant and Sewer lines Expansion and Rehabilitation in the Kaliti Catchment; Addis Ababa Water and Sewerage Authority (AAWSA) Water, Sanitation Rehabilitation and Development Project Office, ESIA Final Report.
- Bokhoree, C., Beeharry, Y., Makoondlall-Chadee, T., Doobah, T. and Soomary, N. (2014). Assessment of environmental and health risks associated with the managementof medical waste in Mauritius. APCBEE Procardia, 9, pp.36-41.
- Brown, P., Wolf, A., and Gajdusek, D.C. (1990). A simple and efective method for inactivating virus infectivity in formalin-fixed tissue samples from patients with Creutzfeldt-Jakob disease. Neurology 40, 887–890.
- Cantor (1996): L. Cantor, "Environmental Impact Assessment," McGraw Hill, Inc., Second Edition (1996).
- CDC (1999); Centres for Disease Control and Prevention, "Biosafety in Microbiologicaland Biomedical Laboratories," report by the Centres for Disease Control andPrevention and the National Institutes of Health, 4th Edition, Washington D.C. (April, 1999).
- CDC-NIH(2001); Center for Disease Control and Prevention - National Institutes of Health, "Biosafety in Microbiologicaland Biomedical Laboratories," report by the U.S. Department of Health and Human Services, Public Health Service, 6th Edition, (Revised June, 2020).
- CSA (2007), Central Statistical Authority the 2007 Population and Housing Census of Ethiopia
- DA (1989): Department of the Army, U. S. Army Medical Research and DevelopmentCommand (USAMRDC), Final Programmatic Environmental Impact Statement; Biological Defense Research Program, "Fort Detrick, Frederick, MD (April 1989).
- Engidasew, T., & Abay, A. (2016). Assessment and Evaluation of Volcanic Rocks Used as Construction Materials in the City of Addis Ababa. Momona Ethiopian Journal of Science, 8, 193. https://doi.org/10.4314/mejs.v8i2.7.
- Environment Policy of Ethiopia, 1997.
- Environmental Assessment Sourcebook, Vol. 3: Guidelines for Environmental Assessment of Energy and Industry Projects. World Bank Technical Paper 154, 1991.
- Environmental Impact Assessment Proclamation № 299/2002.
- Environmental Protection Organs Establishment Proclamation № 295/2002.
- EPA (1997). Environmental policy of Ethiopia.

- EPA (Environmental Protection Authority) (2003). Environmental impact Assessment Guideline document, Addis Ababa, Ethiopia.
- EPA (2007). Strategic Impact Assessment guideline of Ethiopia.
- Ethiopian Environmental Protection Authority 2003. Guideline Ambient Environment Standards for Ethiopia. Environmental Protection Authority and the United Nations Industrial Development Organization, Ecologically Sustainable Industrial Development (ESID) Project.
- ESF/safeguards interim note: COVID-19 considerations in construction/civil works projects, April, 2020
- FMOH Federal Ministry of Health Ethiopia (2004), National Healthcare Waste Management National Guidelines. FMOH Disease Prevention and Control Department. Addis Ababa, Ethiopia.
- Federal Government of Ethiopia (2008), National Healthcare Waste Management National Guidelines
- FDRE Constitution (1995). The Constitution of the Federal Democratic Republic of Ethiopia.
- Federal Government of Ethiopia, Ministry of Education (FMoE) (2015) Growth and Transformation Plan II, 2015/16 – 2019/20.
- Geotechnical Investigation and Foundation Recommendation Report for Ethiopian FoodMedicines Quality Assurance Center of Excellence Complex Project, by ZEHA ETHIOPIAENGINEERING PLC (April, 2020).
- Interim Guidance: COVID-19: Occupational health and safety for health workers, February, 2021.
- Kuzmina, O., Hartrick, E., Marchant, A., Edwards, E., Brandt, J. R., & Hoyle, S. (2022). Chemical Management: Storage and Inventory in Research Laboratories. ACS Chemical Health & Safety, 29(1), 62–71. https://doi.org/10.1021/acs.chas.1c00086
- Mazhindu E, Gumbo T, Gondo T.(2012) Waste Management Threats to Human Health and Urban Aquatic Habitats – A Case Study of Addis Ababa, Ethiopia. *Waste Manag - An Integr Vis*. 2012;(October). https://doi:10.5772/48077
- MOLSA, (2003); Ministry of Labor and Social Affairs, Occupation Health and Safety Directive, Addis Ababa, Ethiopia
- Pasco RF, Fox SJ, Johnston SC, Pignone M, Meyers LA.(2020). Estimated Association of Construction Work with Risks of COVID-19 Infection and Hospitalization in Texas. *JAMA Netw Open.* 2020;3(10):e2026373. https://doi:10.1001/jamanetworkopen.2020.26373.
- Stansfeld, S.A. and Matheson, M.P. (2003) Noise Pollution: Non-Auditory Effects on Health. British Medical Bulletin, 68, 243-257. https://doi.org/10.1093/bmb/ldg033.

- Technical guidance Coronavirus disease (COVID-19): Risk communication and community engagement.
- Tilahun M, Beshaw M. (2020); Customer's Perception and Preference towards Packaged Drinking Water. ScientificWorld Journal. 2020 Feb 29; 2020:6353928.https://doi: 10.1155/2020/6353928. PMID: 32180686; PMCID: PMC7066422.
- WBG, World Bank Group (2007), IFC. Environmental, Health, and Safety (EHS) Guidelines: General EHS Guidelines: WBG 2007.
- WHO (World health organization)(2004), Laboratory Bio-safety Manual, third edition, 2004, Ggeneva.
- WHO (World health organization) (2004); Safe Health-care Waste Management. WHO 2004.
- WHO. Preparation of national health care waste management plans in Sub-Saharan Countries, Guidance manual. WHO, UNEP, Geneva 2005.
- WHO Interim Guidance for Technical Specifications of Personal Protective Equipment for COVID-19, November 2020.
- Wurtz, N., Papa, A., Hukic, M., & Caro, A. Di. (2016). Survey of laboratory-acquired infections around the world in biosafety level 3 and 4 laboratories. Eur J Clin Microbiol Infect Dis, 35, 1247–1258. https://doi.org/10.1007/s10096-016-2657-1

Annex I: Minutes of Community and Stakeholder Consultation for Vaccine Laboratory ESIA

Minutes of Community and Stakeholder Consultation

(Translated from Amharic Language)

Stakeholder and public consultation was conducted on September 07, 2022 at Akaki Kality Sub-city Woreda 05 meeting hall with participants drawn from elders, representatives of religious Institution and with members of the different sector offices from Woreda 09 in Akaki Kality Sub City; and also participants from the EFDA and MOH. A total of 27 people attended the public consultation and 10 of the participants were from the woreda sector offices and representatives of elders and religious institutions; and the other 4 participants were from the EFDA and MOH. The objective of the public consultation was to solicit the views and opinions of the participants towards the prepared ESIA report for construction of the Vaccine laboratory.

Project Background: During the consultation, the participants were briefed on the objectives and purpose of the Vaccine laboratory construction by the EFDA Director representative Mr. Tibebu Abera.The presentation was focused on the importance of the project, its potential impacts and proposed mitigation measures the impacts of during construction and operation phases and the presentation was as follow:

Benefits of the proposed project for the country

The construction of vaccine laboratory if developed will be the biggest laboratory in the country and envisaged to provide its service to other African countries as well. It will contribute in providing high level food, drug and medical equipment testing laboratory service and is expected to resolve and reduce issues that are related to both health and social problems.

Positive impacts due to the project

Participants of the consultation meeting have raised the following positive impacts and the measures that contribute to strengthen it.

1. The construction of the laboratory is expected to contribute in protecting public health by ensuring the safety, effectiveness, quality and proper use of regulated food, drug and medical equipment products that meets national & international standards and the community is highly positive about its construction and is waiting anxiously.

2. The project is expected to create employment opportunity to the local unemployed youth during its construction phase.
3. In its operation phase the laboratory will employ highly skilled and trained professionals and is expected to adopt new and improved technologies.

Measures to strengthen the positive impacts

1. To speed up all the studies that will allow the starting of the construction of the laboratory on planned time without wasting time.
2. The woreda administration and the sector offices under the woreda jurisdiction are willing to provide all required assistance and support from them.

Potential Negative Impacts on the community and Environment

1. Labour issues: During the construction phase of the laboratory, either the main contractor or his sub-contractors should follow FDRE laws and regulation in the employment of construction workers, ensuring labour standards, on time settling of payments and the like. To follow such measures allows the contractor and his sub-contractors to have peaceful working environment.
2. Occupational health and safety: The contractor and his sub-contractors are expected to follow standard occupational health and safety standards during the construction phase of the project.
3. Disposing waste materials: During construction and operation phase it is advised to dispose both solid and liquid waste with affecting the community and the environment in recognized standards.
4. Blocking roads: During construction work, the contractor should avoid storing construction materials, parking of construction machineries and trucks on vehicular and pedestrian walkways.
5. Ensure that installation of glasses on windows and other parts of the building do not have negative impact on the community and environment. The glasses to be installed should be as per the standard of the country.
6. Financial management: All financial issues that are related with the project should follow standard financial management procedures and guidelines and be free from corruption and embezzlement.

Mitigation measures to minimize the negative impacts

1. Establish mechanisms that will allow woreda sector office professionals to carry out follow up and monitoring of the project activities.
2. Ensure that the contractor carries out the construction works as per the rules, regulations and standards of the Environmental Protection Agency.
3. Ensure that the contractor follows occupational, health and safety standards; and labour regulations in employment of his workforce.
4. Monitor the contractor adopts Environmental protection guidelines and procedures
5. Monitor that the financial management system is established as per the law.

Impacts on historical and religious and cultural heritages

According to FDRE proclamation on historical, cultural and religious heritages there are not any recognized and registered historical, cultural and religious heritages site in the project area.

List of participants of the stakeholders and Public consultation

S.N.	Name of Participant	Sex	Organization	Responsibility
1	Kassahun Semere	M	Office from Chief Executive Officer	Chief Executive
2	Abel Teshale	M	Resident/Youth	Community Representative
3	Girma Tulu	M	Resident/Elder	>>
4	Melkamu Hunegnaw	M	Resident/Youth	>>
5	Yohannes Fetene	M	MOH	Safeguard Specialist
6	Yoftaye Yiheyis	M	MOH	Senior Architectural Engineer
7	Anley Taye	M	MOH	Senior Sanitary Engineer
8	Zebidar Mulatu	F	Resident/Woman	Community Representative
9	Getu Hailu	M	Resident/Youth	>>
10	Bizuye Hasibe	F	Resident/Youth/Woman	>>
11	Birhanu Wolde	M	Resident	>>
12	Gissa Tola	M	Resident	>>
13	Ibrahim Fentahun	M	Office from Chief Executive Officer	Public Grievance & Appeal Team Lead
14	Birhane Kebede	F	Office from Woreda 05 Officer	Expert
15	Dagne Debebe	M	Office from Woreda 05 Officer	Social Affair
16	Atiklit Aragaw	F	Resident/Woman	Community Representative
17	Abayneh Mene	M	Resident	>>
18	Birhanu Abrham	M	Office from Woreda 05 Officer	Law Expert
19	Meron G/Mariam	F	Office from Urban Planning	Technical Expert
20	Tewdros Abebe	M	Office from Land Mag't Admin.	Team Leader
21	Alemayehu Nega	M	Office from Health Office	Public Health Expert
22	Haykel Hassen Yesuf	M	Office from Woreda 05 Officer	Expert
23	Hageritu Kebede	F	Resident	>>
24	Tsehay Lealem	F	EFDA	Officer

25	Girum Tesema	M	EFDA	
26	Ejere Tulu	M	EFDA	Office
27	Beyene Zewdu	M	Office from Woreda 05 Officer	Social Affair

Vaccine Laboratory ግንባታ ዙሪያ ከአቃቂ ቃሊቲ ክ/ከተማ ወረዳ 05 ማህበረሰብ ጋር የተደረገ ውይይት

አጀንዳዎች፡

1. ስለግንባታው ፕሮጀክት ውይይት ማድረግ
2. የግንባታ ፕሮጀክቱ ለአካባቢ እና ማህበረሰቡ ያለው ጠቀሜታ ማብራራት
3. የፕሮጀክት ግንባታው በአካባቢ ላይ የሚያስከትለው ተፅህኖዎችና መፍትሔዎች
4. የፕሮጀክት ግንባታው በአካባቢ ላይ የሚያስከትለው ተፅህኖዎችና መፍትሔዎች
5. ግንባታው በሚካሄድበት ዙሪያ ልዩ ትኩረት የሚሹ ቦታዎች (ታሪካዊ፤ህይማኖታዊ) ካሉ የመፍትሔ አቅጣጫዎች

የስብሰባው ቦታ: አቃ/ቃሊቲ ወረዳ 05 አዘጋጅ አዳራሽ

የስብሰባው ቀን:--መጋቢት 10/2015

1. ስለግንባታው ፕሮጀክት ውይይት ማድረግ

የግንባታው ፕሮጀክት ከሚመለከት የኢትዮጵያ ምዕመናና መድህረት ባለስልጣን ጋራ ተገናኝተር አት ሃገሩ አስረና ከጠና ጎጠማ ሚረአዘር ተወካዮች የህንፃው ግንባታ ለምን አገልግሎት እንደአሰፈለገ እና ሲጠቃለፉ የፕሮጀክቱ ጠቃሚነትን ዙሪያ ለተሳታፊዎች ገለፃ አደርገዋል።

ቀጠሮ ለመረጃ ዝንፃ ከኢትዮጵያ ትብብና ምዕመናና መድህረት ደህንነት፤ ጽሪትና መቆጣጠት ምርመራ የሚደረጉበት ቀጠሩዋል።

2. የግንባታ ፕሮጀክቱ ለአካባቢ እና ማህበረሰቡ ያለው ጠቀሜታ ገለፃ መድረግ

የተጠናቀቀው ግንባታ በአጠቃቀሱና ወገብ የምግብና መጠለያ መፈተሻ አውደርዕይ እንደነበሩም ለአፈረሳ ሀገሪት ጉብኝት ሳገለግልበትን የሚችል ነው ሆነው ሙሉ ትጅግ ጉልተኛ ነው።
ግንባታው በመጠናቀቁ ሥራቸውን ደርጅ የምግብ፣ የመጠለያና የህክምና መሳሪያዎች ፍተሻ እንደሚካሄዱበት የዘገቡቱን የህበረተሰቡ ጠቅ ያጠቃልል ከተመቀሪ ሳሀበረሰብ ተጠቃሚዎች በመቆጠብ ደርጅ ጉልተኛ ደርሻ ፈጽሚያለን።

3. የፕሮጀክት ግንባታው በአካባቢ ላይ የሚያስከትለው ተፅዕኖዎችና መፍትሔዎች

3.1. የፕሮጀክት ግንባታው በአካባቢ ላይ የሚያስከትለው ~~አሉታዊ~~ ተፅዕኖዎች

የአለሰላጩ ተቋራጭም የሚጠበቅበትን ጥሩ ጥሩ ነገሮን እንዲ ግዴይዝቱ አጋጥሞ ተፅዕኖ እንደሚደርስ ገለፀዋል።

1. የተቀረጸው መንገድ እንገዳዱና ለሌላጩ መሠረተልማ ችግት የጠቀመ የምግብ እና መጀመሪያ ማጣት የሚያስችል ስለሆነ ቀጽጠጩን ገፅታ የሚቃቀር ስለሆነ ጥገት እንደሚጠቀም ገለፀዋል።
2. ከአካባቢው ለሚገኙ ሥራ አጥ ወገቶች ስግንባታ መቅጠ የሥራ ዕድል ፈጥሯል።
3. ግንባታው ሲጠናቀቅ ስለተ ለተ ወዲ የአለመተ መዳቀቻ ፈጥሯል።
4. ለጊዜው መቅጠ ስለነበቱ ደህንነታቸው ግለተጠቀመ እና ፍተሻ ግለተደረገላቸው የምግብና የመጀመሪያ ግለጫቸው የሚችሉቱ የህበረተሰቡ ችግሮን ፈቅፈሉ።

3.2. የመፍትሔ አቅጣጫዎች

1. ግንባታው ከታቀደለት ቀጠሮ ጋራ እንዲሳተፍ እንዲሰራ ማናቸውም ችግሮች መፈ ሥራ እንዲገጥ ቀደሊግ:

2. ለመረጃው መሰብሰብ የጎንዮሽ መሥሪያ ቤቶች አንዲያስተባብሩት ግንባታ እንዲፈፀሙ ጊጋፋ ጠመሉ ለማድረግ ተጠቁሟል::

4. የፕሮጀክት ግንባታው በአካባቢ ላይ የሚያስከትለው ተፅዕኖዎችና መፍትሔዎች

4.1. የፕሮጀክት ግንባታው በአካባቢ ላይ የሚያስከትለው አሉታዊ ተፅዕኖዎች

i. ለግንባታ መቅጃ ሳንቃረክተሩና ሌሎ-ሳንቃረክተሩ የሥራተኞች ጉዳት እሬፊ የሠገሩትን ጊንጣና ሀገግ ተሰጥቷል መፈፀም ቀኖሮጠቷል:: ቀሠጭ እንዲሰረ እንቅስና ማችግች ይኦከወዳል::

ii. ለሥራ አካባቢ ፖሊሲና ፀረችግና ሃላፊነት (Occupational Health and Safety) ሰጠክለኛው እሠራር ጊንቦን ተሰጥቷል ሚሰሩመን

iii. ለግንባታ መቅጃ ሳግንባታው የሚመጣ ዐረተም ሠሮ ፈቃኝ ጉዳት ለንሳቃቸ የአካባቢ ብክለት ሰጊያመሳል እንዲመጋደ ሰፊደረግ::

iv. የግንባታ ዕቃቃችና አገልግሎች (ተቋራጮችና፣ ሚሸጡሩቃች) መንገዴ ችግሠንሳ ማናቸውንም ጉዳት ሰፊፈሠሩ እንዲያሳስመን ሰፊደረግ

v. ግንባታው ተጠናቅቆ ለንቅቃው ሥራመሠ ቀጥታለች አካባቢመን የማፈጠሸና የጠሩ ሠንጉ እንዲሰሩ. ናቁተኛ ጽዳቃቴ እንዲደረግ

4.2. የመፍትሔ አቅጣጫዎች

→ ግንባታው ከሚሳተፉንበት መቅጃ የመርጫው ሴጠር መ/ቤቶች፣ ለያተጉኝ አገልገሎቶን ቀጥተር ጉዳት የሚደርጉበት ሳሠራር እንዲdme ይሰራል::

→ ግንባታው የሚያቃጀልው ሳንቃረክተር ሥራው ከአካባቢ ጉጠቃና ሀገግ ጊንጣ ወሠደት እንዲኖሳናመን የሳንቃረክቱ ሠል ሰደንቃ እንዲተሳተፉ ቀደሊግ!

→ ሳንቃክአተሩ የሠራተኞች ጉዳት ከሚፈፀፅሙት ወቅት ጉዳትና የሠራተኞች ደህንነት ለንሰሩ መመሪያዎችና ሀተግባር

→ የአካባቢ ጉጠቃና ሕግ እንዲከበሩ ከመወሰን ከሳንክአባሩ ቀደሊግ:

5. ግንባታው በሚካሄድበት ዙሪያ ልዩ ትኩረት የሚሹ ቦታዎች (ታሪካዊ፤ኪይማኖታዊ) ካሉ የመፍትሔ አቅጣጫዎች

ለአንዳንድ የታረክና ቅርሶች ምንገጣ ይንጥ ኝና ሀብ መመረት ከአካባቢው ቢታረክና ሣቁሳናታቹ ቅርስነት ተለይተው የሚገኝ አካፊ አለሳቁ የተጠቀረው ግንባታ ይዚያአስተንለው: የሚ ያዚናቱለው ንዳቂ አቁኖርባ::

Community and Stakeholder consultations attendance sheet for Environmental and Social Impact Assessment for Construction of Vaccine Laboratory Complex at Ethiopian Food and Drug Authority (EFDA)

Federal Democratic Republic of Ethiopia Ministry of Health

Region: አዲስ አበባ Sub-city: ኮልፌ ቀራኒዮ Woreda: 05

Date of Consultation: መጋቢት 10/2015 ዓ.ም

S.N. ተ.ቁ	Name of Participant የተሳታፊ ስም	Sex ፆታ	Organization የሚሰሩበት መ/ቤት	Position የሥራ ድርሻ	Phone No. ስልክ ቁጥር	Signature ፊርማ
1	[illegible]	ወ	[illegible]	[illegible]	[illegible]	
2	[illegible]	ወ	[illegible]	[illegible]	[illegible]	
3	[illegible]	ወ	[illegible]	[illegible]	[illegible]	
4	[illegible]	ወ	[illegible]	[illegible]	[illegible]	
5	[illegible]	ወ	[illegible]	[illegible]	[illegible]	
6	[illegible]	ወ	[illegible]	[illegible]	[illegible]	
7	[illegible]	ወ	[illegible]	[illegible]	[illegible]	
8	[illegible]	ወ	[illegible]	[illegible]	[illegible]	
9	[illegible]	ወ	[illegible]	[illegible]	[illegible]	
10	[illegible]	ሴ	[illegible]	[illegible]	[illegible]	
11	[illegible]	ወ	[illegible]		[illegible]	
12	[illegible]	ወ	[illegible]		[illegible]	
13	[illegible]	ወ	[illegible]	[illegible]	[illegible]	
14	[illegible]	ሴ	[illegible]	[illegible]	[illegible]	
15	[illegible]	ወ	[illegible]	[illegible]	[illegible]	
16	[illegible]	ሴ	[illegible]		[illegible]	
17	[illegible]	ወ	[illegible]		[illegible]	
18	[illegible]	ወ	[illegible]	[illegible]	[illegible]	
19	[illegible]	ሴ	[illegible]	[illegible]	[illegible]	
20	[illegible]	ሴ	[illegible]	[illegible]	[illegible]	
21	[illegible]	ወ	[illegible]	[illegible]	[illegible]	
22	[illegible]	ወ	[illegible]	[illegible]	[illegible]	
23	[illegible]	ሴ	[illegible]	[illegible]	[illegible]	
24	[illegible]	ወ	[illegible]	[illegible]	[illegible]	
25	[illegible]	ወ	[illegible]	[illegible]	[illegible]	
26	[illegible]	ወ	[illegible]	[illegible]	[illegible]	
27	[illegible]	ወ	[illegible]	[illegible]	[illegible]	

Annex II: Environmental and Social Clauses

1. General

a) The Contractor shall comply with any specific Environmental and Social Management Plan (ESMP) for the works he/she is responsible for. The Contractor shall inform himself about such an ESMP and prepare his work strategy and plan to fully take into account relevant provisions of that ESMP.

b) The Contractor shall prepare method statements indicating the period within which he/she shall maintain status on site after completion of civil works to ensure that significant adverse impacts arising from such works have been appropriately addressed.

c) The Contractor shall adhere to the proposed activity implementation schedule and the monitoring plan / strategy to ensure effective feedback of monitoring information to project management so that impact management can be implemented properly, and if necessary, adapt to changing and unforeseen conditions.

d) Besides the regular inspection of the sites by the Supervising Engineer (SE) for adherence to the contract conditions and specifications, the Owner may appoint an inspector to oversee the compliance with these environmental and social conditions and any proposed mitigation measures. Environmental Protection Authority (EPA), regional environmental authorities or other relevant stake holders may carry out similar inspection duties. In all cases, as directed by the SE, the Contractor shall comply with directives from such inspectors to implement measures required to ensure the adequacy of rehabilitation measures carried out on the bio-physical environment and compensation for socio-economic disruption resulting from implementation of all works.

e) The Contractor shall implement all measures necessary to avoid undesirable adverse environmental and social impacts wherever possible, restore work sites to acceptable standards, and abide by any environmental performance requirements specified in an ESMP.

f) If the Contractor fails to implement the approved ESMP after written instruction by the Supervising Engineer (SE) to fulfill his obligation within the requested time, the Owner reserves the right to arrange through the SE for execution of the missing action by a third party on account of the Contractor.

2. Dust abatement

a) The contractor shall minimize the effect of dust on the surrounding environment resulting from earth moving sites, concrete batching plant, heavy truck movement, vibrating equipment, temporary access roads, etc. to ensure safety, health and the protection of workers and communities living in the vicinity dust producing activities.

b) During the performance of the work and any operations appurtenants there to, the contractor shall carry out proper and efficient measures, such as sprinkling with water or other means, whenever necessary to reduce the dust nuisance, and to prevent dust which has originated from his operations from damaging crops, cultivated fields, and dwellings or causing a nuisance to persons. The contractor will be held liable for any damage resulting from dust originating from his operations.

3. Noise due to Construction Activities

The contractor shall ensure the noise levels emanating from machinery, vehicles and noisy construction activities (e.g. excavation, blasting) are kept at a minimum for the safety, health and protection of workers within the vicinity of high noise levels and nearby communities.

The national noise limit standard for the residential area in day time is 55 dB while at night is 45 dB.

4. River, Stream and Creek Obstruction and flooding

a) The contractor shall ensure the existing water flow regimes in rivers, streams and other natural or irrigation channels are maintained and/or re-established where they are disrupted due to works being carried out.

b) The contractor shall take all possible steps to prevent pollution of streams, rivers and other natural water bodies / reservoirs and prevent flooding related to the construction activity,

c) Bitumen, oils, lubricants and waste water used or produced during the execution of works will not be released directly into rivers, streams, irrigation channels and other natural water bodies/reservoirs without prior treatments and also ensure that stagnant water in uncovered borrow pits is treated in the best way to avoid creating possible breeding grounds for mosquitoes.

5. Quarrying, Earth Burrowing, etc.

a) Prevent and minimize the impacts of quarrying, earth borrowing, piling and building of temporary construction camps and access roads on the biophysical environment including protected areas and arable lands; local communities and their settlements. In as much as possible restore/rehabilitate all sites to acceptable standards.

b) At the end of the construction phase, all construction sites shall be landscaped and rehabilitated to acceptable standards. The stated areas shall be first landscaped, dressed with topsoil and covered with tree planting, field sods or grass seeding.

6. Protection of Archeological and Historical Sites

a) Upon discovery of ancient heritage, relics or anything that might or believed to be of archeological or historical importance during the execution of works, immediately suspend and report such findings to the SE so that the appropriate authorities may be expeditiously contacted for fulfillment of the measures aimed at protecting such historical or archaeological resources.

b) The contractor shall take the necessary measures for preventing that any person or equipment may damage the article or things and shall provide barricades, fences, and signals and, if necessary, protect against atmospheric agents, as directed by the engineer. Also guard service may be required by the engineer.

c) The supervising engineer shall take the following measures:

- Notify the relevant department of antiquities,
- Request for representative to make site inspection,
- Secession of work in the vicinity of the find until the visit of representative; and
- Decision by the department of antiquities on possible salvage or excavation within 48-72 hours of notification

7. Vegetation and Wildlife

a) Discourage construction workers from engaging in the exploitation of natural resources such as hunting, fishing, and collection of forest products or any other activity that might have a negative impact on the social and economic welfare of the local communities.

b) The contractor shall care, in planning, constructing, maintaining and operating temporary works such as camps, roads, spoil, stockpile and construction facilities areas, to avoid unnecessary damage to areas of particular environmental interest, such as patches of remaining forest, valuable trees and erosion sensitive areas, as well as areas in which the presence of wildlife has been noted.

c) In case some part of forest or single trees has to be removed, or where erosion problems that may affect some portion of the permanent or temporary works are expected, and in any case where in the engineer's opinion it is beneficial for the land conservation,

landscaping, seeding and planting of trees, as well as executing drainages and water control works may be required to the contractor, who shall carry out the work according to the prescriptions contained in the pertinent sections of these specifications.

d) No valuable trees or crops shall be damaged or removed by the contractor during the execution of the works without the prior consent of the engineer.
e) Hunting in the proximity of camps and facilities and in general in the project area is strictly prohibited, even if allowed by local rules or regulation in force in Ethiopia and or in the project region.

8. Use of Material

The contractor, in as much as possible, shall use local materials to avoid importation of foreign material and long-distance transportation.

9. Worksite/Camp Site Waste Management

a) All vessels (drums, containers, bags, etc.) containing oil/fuel/surfacing materials and other hazardous chemicals shall be banded in order to contain spillage. Used oil and hydraulic fluid generated on the construction sites must be collected in a closed container and stored temporarily in a safe place and sent to an authorized recycling depot.
b) All drainage and effluent from storage areas, workshops and camp sites shall be captured and treated before being discharged into the drainage system in line with applicable government water pollution control regulations.
c) The contractor shall take all possible steps to prevent pollution of streams, rivers, and other water supplies, at or in the vicinity of the site and shall comply with applicable laws, orders and regulations in force in the country of the works concerning the control and abatement of water pollution.
d) Entry of runoff to the site shall be restricted by constructing diversion channels or holding structures such as banks, drains, dams, etc. to reduce the potential of soil erosion and water pollution.
e) Construction waste shall not be left in stockpiles along the road, but removed and reused or disposed of on a daily basis and should be also restricted within the project site.
f) If disposal sites for clean spoil are necessary, they shall be located in areas, approved by the SE, for landfill and where they will not result in material being easily washed into drainage channels. Whenever possible, spoil materials should be placed in low-lying areas and should be compacted and dressed with top soil and then planted with species indigenous to the locality.
g) The contractor shall provide all sanitary facilities (e.g. garbage collection and disposal, safety tank, drinking water facilities, etc.) are provided in construction workers camps.

10. Material Excavation and Deposit

a) The Contractor shall obtain appropriate licenses/permits from relevant authorities to operate quarries or borrow areas.

b) The location of quarries and borrow areas shall be subject to approval by relevant local and national authorities, including traditional authorities if the land on which the quarry or borrow areas fall in traditional land.

c) New extraction sites:

- Shall not be located in the vicinity of settlement areas, cultural and historical sites, wetlands or any other valued ecosystem component, or on high or steep ground or in areas of high scenic value.
- Shall not be located in archaeological areas. Excavations in the vicinity of such areas shall proceed with great care and shall be done in the presence of government authorities having a mandate for their protection.
- Shall not be located in forest reserves. However, where there are no other alternatives, permission shall be obtained from the appropriate authorities and an environmental and social impact study shall be conducted.
- Shall be easily rehabilitated. Areas with minimal vegetation cover such as flat and bare ground, or areas covered with grass only or covered with shrubs less than 1.5m in height, are preferred.
- Shall have clearly demarcated and marked boundaries to minimize vegetation clearing and to avoid any unnecessary damage on other resources.

d) Vegetation clearing shall be restricted to the area required for safe operation of construction work. Vegetation clearing shall not be done more than two months in advance of operations.

e) Stockpile areas shall be located in areas where trees can act as buffers to prevent dust pollution. Perimeter drains shall be built around stockpile areas. Sediment and other pollutant traps shall be located at drainage exits.

f) The Contractor shall deposit any excess material in accordance with the principles of these general conditions, and any applicable ESMP, in areas approved by local authorities and/or the SE.

g) Areas for depositing hazardous materials such as contaminated liquid and solid materials shall be approved by the SE and appropriate local and/or national authorities before the commencement of work. Use of existing, approved sites shall be preferred over the establishment of new sites.

11. Rehabilitation and Soil Erosion Prevention

a) To the extent practicable, the Contractor shall rehabilitate the site progressively so that the rate of rehabilitation is similar to the rate of construction.

b) Always remove and retain topsoil for subsequent rehabilitation. Soils shall not be stripped when they are wet as this can lead to soil compaction and loss of structure.

c) Topsoil shall not be stored in large heaps. Low mounds of no more than 1 to 2m high are recommended.

d) Re-vegetate the stockpiles with recommended grass species to protect the soil from erosion, discourage weeds and maintain an active population of beneficial soil microbes.

e) Locate stockpiles where they will not be disturbed by future construction activities.

f) The contractor shall reinstate natural drainage patterns where they have been altered or impaired.

g) The contractor shall collect toxic materials from construction areas and keep protect in designated sites until proper disposal. Backfill excavated areas with soils or overburden that is free of foreign material that could pollute groundwater and soil.

h) Identify potentially toxic overburden and screen with suitable material to prevent mobilization of toxins.

i) Ensure reshaped land is formed so as to be inherently stable, adequately drained and suitable for the desired long-term land use, and allow natural regeneration of vegetation.

j) Minimize the long-term visual impact by creating landforms that are compatible with the adjacent landscape.

k) Minimize erosion by wind and water both during and after the process of reinstatement.

l) Compacted surfaces shall be deep ripped to relieve compaction unless subsurface conditions dictate otherwise.

m) Re-vegetate with plant species that will control erosion, provide vegetative diversity and, through succession, contribute to a resilient ecosystem. The choice of plant species for rehabilitation shall be done in consultation with local research institutions, forest department and the local people.

12. Water Resources Management

a) The Contractor shall at all costs avoid conflicting with water demands of local communities.

b) Abstraction of both surface and underground water shall only be done with the consultation of the local community and after obtaining a permit from the relevant Water Authority.

c) Abstraction of water from wetlands shall be avoided. Where necessary, permission has to be obtained from relevant authorities.

d) No construction water containing spoils or site effluent, especially cement and oil, shall be allowed to flow into natural water drainage courses.

e) Wash water from washing out of equipment shall not be discharged into water courses without pretreated.

f) Site spoils and temporary stockpiles shall be located away from the drainage system, and surface runoff shall be directed away from stockpiles to prevent erosion.

13. Traffic Management

a) Location of access roads shall be done in consultation with the local community especially in important or sensitive environments. Access roads shall not traverse wetland areas.

b) Upon the completion of civil works, all access roads shall be ripped and rehabilitated

c) Access roads shall be watered regularly to suppress dust emission.

14. Disposal of Unusable Elements

a) Unusable materials and construction elements such as electro-mechanical equipment, pipes, accessories and demolished structures will be disposed of in a manner approved by the SE. The Contractor has to agree with the SE which elements are to be surrendered to the Client's premises, which will be recycled or reused, and which will be disposed of at approved landfill sites.
b) Unsuitable and demolished elements shall be dismantled to a size fitting on ordinary trucks for transport.

15. Repair of Private Property

a) Should the Contractor, deliberately or accidentally, damage private property, he shall repair the property to the owner's satisfaction and at his own cost. For each repair, the Contractor shall obtain from the owner a certificate that the damage has been made good satisfactorily in order to indemnify the Client from subsequent claims.
b) In cases where compensation for inconveniences, damage of crops etc. are claimed by the owner, the Client has to be informed by the Contractor through the SE. This compensation is in general settled under the responsibility of the Client before signing the Contract. In unforeseeable cases, the respective administrative entities of the Client will take care of compensation.

16. Contractor's Environment, Health and Safety Management Plan (EHS- MP)

Within 6 weeks of signing the Contract, the Contractor shall prepare an EHS-MP to ensure the adequate management of the health, safety, environmental and social aspects of the works, including implementation of the requirements of these general conditions and any specific requirements of an ESMP for the works.

The Contractor's EHS-MP will serve two main purposes:-

a) For the Contractor, for internal purposes, to ensure that all measures are in place for adequate EHS management, and as an operational manual for his staff, and,
b) For the Client, supported where necessary by SE, to ensure that the Contractor is fully prepared for the adequate management of the EHS aspects of the project, and as a basis for monitoring of the Contractor's EHS performance.

The Contractor's EHS-MP shall provide at least:-

- a description of procedures and methods for complying with these general environmental and social management conditions, and any specific conditions specified in an ESMP;
- a description of specific mitigation measures that will be implemented in order to minimize adverse impacts.
- a description of all planned monitoring activities (e.g. sediment discharges from borrow areas) and the reporting thereof; and
- The internal organizational, management and reporting mechanisms put in place for such.

The Contractor's EHS-MP will be reviewed and approved by the Client before start of the works. This review should demonstrate if the Contractor's EHS-MP covers all of the identified impacts and has defined appropriate measures to counteract any potential impacts.

16.1. Health and Safety

a) The contractor shall ensure that the project adheres to the Environmental, Health and Safety Guidelines in the ESMP.
b) In advance of the construction work, the Contractor shall mount an awareness and hygiene campaign. Workers and local residents shall be sensitized on health risks particularly of HIV/AIDS.
c) Adequate road signs to warn pedestrians and motorists of construction activities, diversions, etc. shall be provided at appropriate points.
d) Construction vehicles shall not exceed maximum speed limit of 40km per hour.

16.2. Traffic Safety

a) Ensure public safety, and meet traffic safety requirements for the operation of work to avoid accidents.
b) The contractor shall be responsible for the safety along the roads related to the site, and he shall take all necessary precautions for the protection of the work and the safety of the public on the roads affected by his activities.
c) Roads subject to interference by the work shall be kept open or suitable detours shall be provided and maintained by the contractor, who shall provide, erect, and maintain all necessary barricades, suitable and sufficient flashlights, flagmen, danger signals, and signs.

d) The contractor shall submit his weekly activities schedule and the locations of his work along the existing public roads to the authorities concerned, and obtain all necessary approvals prior to commencement of the respective work.

e) At the road crossings or in heavy traffic locations, the contractor shall carry out the work within the working hours as directed by the engineer, and after the completion of the work he shall immediately make the necessary backfill and pavement at the crossings.

f) The contractor shall provide temporary passes and bridges to give an access to the existing villages, houses, etc., to the satisfaction of the engineer and the authorities concerned whenever he disturbs such existing way during the execution of the works.

17. Reporting

The Contractor shall prepare monthly progress reports to the SE on compliance with these general conditions, the project ESMP if any, and his own EHS-MP. It is expected that the Contractor's reports will include information on:-

- EHS management actions/measures taken, including approvals sought from local or national authorities.
- Problems encountered in relation to EHS aspects (incidents, including delays, cost consequences, etc., as a result thereof).
- Lack of compliance with contract requirements on the part of the Contractor.
- Changes of assumptions, conditions, measures, designs and actual works in relation to EHS aspects; and
- Observations, concerns raised and/or decisions taken with regard to EHS management during site meetings.

It is advisable that reporting of significant EHS incidents be done "as soon as practicable". Such incident reporting shall therefore be done individually. Also, it is advisable that the Contractor keeps his own records on health, safety and welfare of persons, and damage to property. It is advisable to include such records, as well as copies of incident reports, as appendixes to the bi-weekly reports. Example formats for an incident notification and detailed report are given below. Details of EHS performance will be reported to the Client through the SE's reports to the Client.

18. Training of Contractor's Personnel

The Contractor shall provide sufficient training to his own personnel to ensure that they are all aware of the relevant aspects of these general conditions, any project EMP, and his own EHS-MP, and are able to fulfill their expected roles and functions. Specific training should be provided to those employees that have particular responsibilities associated with the implementation of the EHS-MP. General topics should be.

- EHS in general (working procedures)
- Emergency procedures; and
- Social and cultural aspects (awareness creation)

19. Cost of Compliance

It is expected that compliance with these conditions is already part of standard good workmanship and state of art as generally required under this Contract. The item "Compliance with Environmental and Social Management Conditions" in the Bill of Quantities covers these costs. No other payments will be made to the Contractor for compliance with any request to avoid and/or mitigate an avoidable EHS impact.

Annex III: Code of Conduct for Contractors and worker shired under the project General Code of Conduct for vaccine lab building project to be inserted in the ESMP and/or Tender documents and Contract

The vaccine laboratory building project will comply with ESS2 and ESS4 and the Environmental, Social Health and Safety Guidelines of the WB (ESHS) and the Occupational Health and Safety (OHS) and Labor regulations of Ethiopia. The following is a general Code of conduct to be inserted in the contract of contractors for civil works or other contracted activities.

1. **Company Code of Conduct for Implementing ESHS and OHS Standards, Preventing Gender Based Violence and Violence against Children**

---------- (company name) is committed to ensuring that the project is implemented in such a way which minimizes any negative impacts on the local environment, communities, and its workers. This shall be done by respecting the environmental, social, health and safety (ESHS) standards, and ensuring appropriate occupational health and safety (OHS) standards are met. The company is also committed to creating and maintaining an environment in which gender-based violence (GBV) and violence against children (VAC) have no place, and where they shall not be tolerated by any employee, associate, or representative of the company.

Therefore, in order to ensure that all those engaged in the project are aware of this commitment, the company commits to the following core principles and minimum standards of behavior that shall apply to all company employees, associates, and representatives including sub-contractors, without exception:

General

1. The company, and therefore all employees, associates, and representatives, commits to complying with all relevant national laws, rules and regulations and the World Bank Environmental and Social Standards which can read in the internet in this website:
    a. https://www.worldbank.org/en/projects-operations/environmental-and-social-framework
2. The contractor is responsible to comply with the requirements defined in ESMP which are

integral part of the contract.

3. The company commits to full implementing its 'Contractors Environmental and Social Management Plan' (C-ESMP) which will be prepared based on the ESIA/ESMP prepared by the government for the works.
4. The company commits to treating women, children (persons under the age of 18), and men with respect regardless of race, colour, language, religion, political or other opinion, national, ethnic or social origin, property, disability, birth or other status. Acts of GBV and VAC are in violation of this commitment.
5. The company shall ensure that interactions with local community members are done with respect and non-discrimination.
6. Demeaning, threatening, harassing, abusive, culturally inappropriate, or sexually provocative language and behaviour are prohibited among all company employees, associates, and its representatives.
7. Respect to reasonable work instructions (including regarding environmental and social norms)
8. Protect and ensure proper use of property (for example, to prohibit theft, carelessness or waste)
9. Prohibit illegal activities by their workers such as: polluting the soil, rivers, wetlands, hunting, poaching wildlife, setting up fires, spilling diesel, oils in the soil, cutting trees without permit.

HealthandSafety

10. The company shall ensure to hire professional in occupational health and safety to implement the ESMP.
11. The company shall ensure that the project's occupational health and safety (OHS) management plan is effectively implemented, including wearing prescribed personal protective equipment, preventing avoidable accidents and reporting accidents of all type within less of 24 hours or conditions or practices in the project sites that pose a safety hazard or threaten the environment and the people.
12. Thecompanywill:
    a. Prohibittheuseofalcoholduringworkactivities.
    b. Thecompanyshallprohibittheuseofillegalsubstances,atalltimes.

13. The company shall ensure that adequate eating, changing and sanitation facilities are available on site and at any worker accommodations provided by the contractor.
14. The company will obey labour, contracting and health and safety regulation in case of accidents, death and incapacity of workers (skilled or no skilled) and pay the compensation required by law.

GenderBasedViolenceandViolenceagainst Children

15. Acts of GBV or VAC constitute gross misconduct and are therefore grounds for sanctions, which may include penalties and/or termination of employment. All forms of GBV and VAC, including grooming are unacceptable, regardless of whether they take place on the work site, the work site surroundings, at worker's camps or at worker's homes.
16. In addition to company sanctions, legal prosecution of those who commit acts of GBV or VAC shall be pursued if appropriate.
17. Sexual contact or activity with children under 18—including through digital media—is prohibited. Mistaken belief regarding the age of a child is not a defense. Consent from the child is also not a defense or excuse.
18. Sexual Harassment—for instance, making unwelcome sexual advances, requests for sexual favors, and other verbal or physical conduct, of a sexual nature, including subtle acts of such behavior, is prohibited. For example: Looking somebody up and down; kissing, howling or smacking sounds; hanging around somebody; whistling and catcalls; giving personal gifts; making comments about somebody's sex life; etc. is prohibited.
19. Sexual favors —for instance, making promises or favorable treatment dependent on sexual acts—or other forms of humiliating, degrading or exploitative behavior are prohibited.
20. Unless there is full consent by all parties involved in the sexual act, sexual interactions between the company's employees (at any level) and members of the communities surrounding the work-place are prohibited. This includes relationships involving the withholding/promise of actual provision of benefit (monetary or non-monetary) to community members in exchange for sex—such sexual activity is considered "non-consensual" within the scope of this Code.

21. All employees, including volunteers and sub-contractors are highly encouraged to report suspected or actual acts of GBV and/or VAC by a fellow worker, whether in the same company or not. Reports must be made in accordance with GBV and VAC Allegation Procedures.
22. Managers are required to report suspected or actual acts of GBV and/or VAC as theyhave a responsibility to uphold company commitments and hold their direct reports responsible.

Implementation

Toensurethattheaboveprinciplesareimplemented effectivelythecompanycommitstoensuring that:

23. All managers sign the 'Manager's Code of Conduct' detailing their responsibilities for implementing the company's commitments and enforcing the responsibilities in the 'Individual Code of Conduct'.
24. All employees sign the project's 'Individual Code of Conduct' confirming their agreement to comply with ESHS and OHS standards, and not to engage in activities resulting in GBV or VAC.
25. Displaying the Company and Individual Codes of Conduct prominently and in clear view at workers' camps, offices, and in in public areas of the work-place. Examples of areas include waiting, rest and lobby areas of sites, canteen areas, health clinics.
26. Ensure that posted and distributed copies of the Company and Individual Codes of Conduct are translated into the appropriate language of use in the work site areas as well as for any international staff in their native language.
27. An appropriate person is nominated as the company's 'Focal Point' for addressing GBV and VAC issues, including representing the company on the GBV and VAC Compliance Team which is comprised of representatives from the client, contractor(s), the supervision consultant, and local service provider(s).
28. Ensuring that an effective GBV and VAC Action Plan is developed in consultation with the Compliance Team which includes as a minimum:
    a. **GBV and VAC Allegation Procedure** to report GBV and VAC issues through the project Grievance Redress Mechanism (GRM);
    b. **AccountabilityMeasures**toprotectconfidentialityofallinvolved;and,

c. **ResponseProtocol**applicabletoGBVandVACsurvivorsand perpetrators.

29. That the company effectively implements the GBV and VAC Action Plan, providing feedback to the Compliance Team for improvements and updates as appropriate.
30. All employees attend an induction training course prior to commencing work on site to ensure they are familiar with the company's commitments to ESHS and OHS standards, and the project's GBV and VAC Codes of Conduct.
31. All employees attend a mandatory training course once a month for the duration of the contract starting from the first induction training prior to commencement of work to reinforce the understanding of the project's ESHS and OHS standards and the GBV and VAC Code of Conduct.

IdoherebyacknowledgethatIhavereadtheforegoingCompanyCodeofConduct,andonbehalf of the company agree to comply with the standards contained therein. I understand my role and responsibilities to support the project's OHS and ESHS standards, and to prevent and respond to GBV and VAC. I understand that any action inconsistent with this Company Code of Conduct or failure to take action mandated by this Company Code of Conduct may result in disciplinary action.

Company name: _____

Signature: _____

2. Manager'sCodeofConduct

Manager's Code of Conduct Implementing ESHS and OHS Standards and Preventing Gender Based Violence and Violence against Children

Managers at all levels have a responsibility to uphold the company's commitment toimplementing the ESHS and OHS standards, and preventing and addressing GBV and VAC. This means that managers have an acute responsibility to create and maintain an environment that respects these standards and prevents GBV and VAC. Managers need to support and promote the implementation of the Company Code of Conduct. To this end, managers must adhere this Manager's Code of Conduct and also sign the Individual Code of Conduct. This commits them to supporting the implementation of the C-ESMP and the OHS Management Plan and developing systems that facilitate the

implementation of the GBV and VAC Action Plan. They need to maintain a safe workplace, as well as a GBV-free and VAC-free environment at the workplace and in the local community. These responsibilities include but are not limited to:

Implementation

1. ToensuremaximumeffectivenessoftheCompanyandIndividualCodesofConduct:
    a. Prominently displaying the Company and Individual Codes of Conduct in clear view at workers' camps, offices, and in in public areas of the work-place. Examples of areas include waiting, rest and lobby areas of sites, canteen areas, health clinics.
    b. Ensuring all posted and distributed copies of the Company and Individual Codes of Conduct are translated into the appropriate language of use in the work site areas as well as for any international staff in their native language.
2. Verbally and in writing explain the Company and Individual Codes of Conduct to all staff.
3. Ensure that:
    a. All direct reportees sign the 'Individual Code of Conduct', including acknowledgment that they have read and agree with the Code of Conduct.
    b. Staff lists and signed copies of the Individual Code of Conduct are provided to the OHS Manager, the Compliance Team, and the client.
    c. Participate in training and ensure that staff also participate as outlined below.
    d. Put in place a mechanism for staff to:
        i. reportconcernsonESHSorOHScompliance; and,
        ii. confidentiallyreportGBVorVACincidentstotheGrievanceRedress Mechanism (GRM)
    e. Staff are encouraged to report suspected or actual ESHS, OHS, GBV or VAC issues, emphasizing the staff's responsibility to the Company and the country hosting their employment, and emphasizing the respect for confidentiality.
4. In compliance with applicable laws and to the best of your abilities, prevent perpetrators of sexual exploitation and abuse from being hired, re-hired or deployed. Use background and criminal reference checks for all employees.

5. Ensure that when engaging in partnership, sub-contractor or similar agreements, these agreements:
    a. Incorporate the ESHS, OHS, GBV and VAC Codes of Conduct as an attachment.
    b. Include the appropriate language requiring such contracting entities and individuals, and their employees and volunteers, to comply with the Individual Codes of Conduct.
    c. expressly state that the failure of those entities or individuals, as appropriate, to ensure compliance with the ESHS and OHS standards, take preventive measures against GBV and VAC, to investigate allegations thereof, or to take corrective actions when GBV or VAC has occurred, shall constitute grounds for sanctions and penalties in accordance with the Individual Codes of Conduct.
6. Provide support and resources to the Compliance Team to create and disseminate internal sensitization initiatives through the awareness-raising strategy under the GBV and VAC Action Plan.
7. Ensure that any GBV or VAC issue warranting police action is reported to the client and the World Bank immediately.
8. Ensure that any major ESHS or OHS incidents are reported to the client and the supervision engineer immediately.

Training

9. The managers are responsible to:
    a. Ensure that the OHS Management Plan is implemented, with suitable training required for all staff, including sub-contractors and suppliers; and,
    b. Ensure that staffs have a suitable understanding of the C-ESMP and are trained as appropriate to implement the C-ESMP requirements.
10. All managers are required to attend an induction manager training course prior to commencing work on site to ensure that they are familiar with their roles and responsibilities in upholding the GBV and VAC elements of these Codes of Conduct. This training shall be separate from the induction training course required of all employees and shall provide

managers with the necessary understanding and technical support needed to begin to develop the GBV and VAC Action Plan for addressing GBV and VAC issues.

11. Managers are required to attend and assist with the project facilitated monthly training courses for all employees. Managers shall be required to introduce the trainings and announce the self-evaluations, including collecting satisfaction surveys to evaluate training experiences and provide advice on improving the effectiveness of training.
12. Ensure that time is provided during work hours and that staff prior to commencing work on site attend the mandatory project facilitated induction training on:
    a. OHS and ESHS; and,
    b. GBV and VAC required of all employees.
13. During civil works, ensure that staff attends ongoing OHS and ESHS training, as well as the monthly mandatory refresher training course required of all employees to combat increased risk of GBV and VAC.

Response

14. Managers shall be required to take appropriate actions to address any ESHS or OHS incidents.
15. With regard to GBV and VAC:
    a. Provide input to the GBV and VAC Allegation Procedures and Response Protocol developed by the Compliance Team as part of the final cleared GBV and VAC Action Plan.
    b. Once adopted by the Company, managers shall uphold the Accountability Measures set forth in the GBV and VAC Action Plan to maintain the confidentiality of all employees who report or (allegedly) perpetrate incidences of GBV and VAC (unless a breach of confidentiality is required to protect persons or property from serious harm or where required by law).
    c. If a manager develops concerns or suspicions regarding any form of GBV or VAC by one of his/her direct reports, or by an employee working for another contractor on the same work site, s/he is required to report the case using the GRM.

d. Once a sanction has been determined, the relevant manager(s) is/are expected to be personally responsible for ensuring that the measure is effectively enforced, within a maximum timeframe of 14 days from the date on which the decision to sanction was made.
e. If a Manager has a conflict of interest due to personal or familial relationships with the survivor and/or perpetrator, he/she must notify the respective company and the Compliance Team. The Company shall be required to appoint another manager without a conflict of interest to respond to complaints.

16. Managers failing to address ESHS or OHS incidents or failing to report or comply with the GBV and VAC provisions may be subject to disciplinary measures, to be determined and enacted by the company's CEO, Managing Director or equivalent highest-ranking manager. Those measures may include:
    a. Informalwarning.
    b. Formal warning.
    c. AdditionalTraining.
    d. Lossofuptooneweek'ssalary.
    e. Suspensionof employment(without payment of salary),for aminimum periodof 1 month up to a maximum of 6 months.
    f. Terminationofemployment.
17. Ultimately, failure to effectively respond to ESHS, OHS GBV and VAC cases on the work site by the company's managers or CEO may provide grounds for legal actions by authorities.

I do hereby acknowledge that I have read the foregoing Manager's Code of Conduct, do agree to comply with the standards contained therein and understand my roles and responsibilities to prevent and respond to ESHS, OHS GBV and VAC requirements. I understand that any action inconsistent with this Manager's Code of Conduct or failure to take action mandated by this Manager's Code of Conduct may result in disciplinary action.

Signature: _____

Printed Name:_____

Title: _____

3. **Code of Conduct to be signed by individual workers (skilled and unskilled, casual or non-casual) for Preventing Gender Based Violence (GBV) and Violence against Children (VAC)**

I, _____, acknowledge that adhering to environmental, social health and safety (ESHS) standards, following the project's occupational health and safety (OHS) requirements, and preventing gender-based violence (GBV) and violence against children (VAC) is important. All forms of GBV or VAC are unacceptable, be it on the work site, the work site surroundings, at worker's camps, or the surrounding communities.

The company considers that failure to follow ESHS and OHS standards, or to partake in GBV orVAC activities, constitute acts of gross misconduct and are therefore grounds for sanctions, penalties or potential termination of employment. Prosecution of those who commit GBV or VAC may be pursued if appropriate.

IagreethatwhileworkingontheprojectIwill:

- Attend and actively partake in training courses related to ESHS, OHS, HIV/AIDS, GBV and VAC as requested by my employer.
- Shall wear my personal protective equipment (PPE), in the correct prescribed manner, at all times when at the work site or engaged in project related activities.
- Take all practical steps to implement the contractor's environmental and social management plan (CESMP).
- ImplementtheOHSManagementPlan.
- Adheretoazero-alcoholpolicyduringworkactivities,andrefrainfromtheuseofillegal substances at all times.
- Consenttoapolicebackgroundcheck.
- Treatwomen,children(personsundertheageof18),andmenwithrespectregardlessofrace, color, language, religion, political or other opinion, national, ethnic or social origin, property, disability, birth or other status.
- Not use language or behavior towards women, children or men that is inappropriate, harassing, abusive, sexually provocative, demeaning or culturally inappropriate.
- Not participate in sexual contact or activity with children—including grooming or contact through digital media. Mistaken belief regarding the age of a child is not a defense.

Consent from the child is also not a defense or excuse.

- Not engage in sexual harassment—for instance, making unwelcome sexual advances,requests for sexual favors, and other verbal or physical conduct, of a sexual nature, including subtle acts of such behavior. Ex. Looking somebody up and down; kissing, howling or smacking sounds; hanging around somebody; whistling and catcalls; giving personal gifts; making comments about somebody's sex life; etc.
- Not engage in sexual favors—for instance, making promises or favorable treatmentdependent on sexual acts—or other forms of humiliating, degrading or exploitative behavior.

- Unless there is the full consent[11] by all parties involved, I shall not have sexual interactions with members of the surrounding communities. This includes relationships involving the withholdingorpromiseofactualprovisionofbenefit(monetaryornon-monetary)to community members in exchange for sex—such sexual activity is considered "non- consensual" within the scope of this Code.
- Consider reporting through the GRM (Grievance Redress Mechanism) or to my manager any suspected or actual GBV or VAC by a fellow worker, whether employed by my employer or not, or any breaches of this Code of Conduct.

Withregardtochildrenundertheageof18:

- Wherever possible, ensure that another adult is present when working in the proximity of children.
- Not invite unaccompanied children unrelated to my family into my home, unless they are at immediate risk of injury or in physical danger.
- Not sleep close to unsupervised children unless absolutely necessary, in which case I must obtain my supervisor's permission, and ensure that another adult is present if possible.
- Use any computers, mobile phones, or video and digital cameras appropriately, and never to exploit or harass children or to access child pornography through any medium (see also "Use of children's images for work related purposes" below).
- Refrainfromphysicalpunishmentordisciplineofchildren.
- Refrain from hiring children for domestic or other labor which is inappropriate given

theirage or developmental stage, which interferes with their time available for education and recreational activities, or which places them at significant risk of injury.

- Complywithallrelevantlocallegislation,includinglaborlawsinrelationtochildlabor.

Useofchildren'simagesforworkrelated purposes

Whenphotographingorfilmingachildforworkrelatedpurposes,Imust:

- Before photographing or filming a child, assess and endeavor to comply with local traditions or restrictions for reproducing personal images.
- Before photographing or filming a child, obtain informed consent from the child and a parent or guardian of the child. As part of this I must explain how the photograph or film shall be used.
- Ensure photographs, films, videos and DVDs present children in a dignified and respectful manner and not in a vulnerable or submissive manner. Children should be adequately clothed and not in poses that could be seen as sexually suggestive.
- Ensureimagesarehonestrepresentationsofthecontextandthefacts.
- Ensure file labels do not reveal identifying information about a child when sending images electronically.

Sanctions

IunderstandthatifIbreachthisIndividualCodeofConduct,myemployershalltakedisciplinary action which could include:

- Informalwarning.
- Formal warning.
- AdditionalTraining.
- Lossofuptooneweek'ssalary.
- Suspensionof employment(withoutpayment ofsalary), for aminimum periodof1 month up to a maximum of 6 months.
- Terminationofemployment.
- Reporttothepoliceif wanted.

I understand that it is my responsibility to ensure that the environmental, social, health and safety standardsaremet.ThatIshalladheretotheoccupational health and safety managementplan. ThatI

shall avoid actions or behaviors that could be construed as GBV or VAC. Any such actions shall be a breach this Individual Code of Conduct. I do hereby acknowledge that I have read the foregoing Individual Code of Conduct, do agreetocomply withthe standardscontainedthereinandunderstand my roles and responsibilities to prevent and respond to ESHS, OHS, GBV and VAC issues. I understand that any actioninconsistent with this Individual Code of Conduct or failure to take action mandated by this Individual Code of Conduct may result in disciplinary action and may affect my ongoing employment.

Signature: _____

Printed Name:_____

Title: _____

Date: _____

Contractor_____

_____Su

pervisor_____

_____Da

te_____

Annex IV: Emergency Preparedness and Response Plan for the project

Emergencies and disasters can occur any time without warning. More so construction sites are prone to such, thus it is important for the proponent to prepare for them, and be in a good position to act to minimize panic and confusion when they occur. Emergency Preparedness and Response Plans (EPRP) will have to be instituted throughout the project cycle.The following elements of a conventional emergency response plan are recommended as summarized in table 9 below.

Table 14: Emergency Preparedness and Response Plan

Emergency Preparedness and ResponsePlanComponents	Actions/Requirements	Responsibility
Potential Emergency	• Identification of all potential emergencies associated with the proposed project at theprojectsite,Include,Fires,Accidents& Incidents, and Securityetc.	• Contractorduring construction and Decommissioningphases. • Proponentduringoperationphase.
Emergency Operations Coordinator (EOC)	• Designateaprimaryandsecondary contact person.	• Contractorduringconstructionand decommissioningphases. • Proponentduringoperationphase.
Emergency contact Numbers	• Give&displaycontactforFirestation, Ambulance,police,Hospitals,andothers	• Contractorduringconstructionand decommissioningphases • Proponentduringoperationphase.
Installationof emergency equipment	• Firesensors, • Firealarms, • Fireextinguishers, • Firehose, • Panicalarmbutton, • Provisionandenforcementofuseof PPEs, • EmergencyCommunicationequipment, suchasPhone&alarmbells	• Contractorduringconstructionand decommissioningphases. • Proponentduringoperationphase.
Trainingfor emergency response	• Regulartrainingforemergencyresponse	• Contractorduringconstructionand decommissioningphases. • Proponent,duringoperationphase
Trainedintheuse of emergency equipment	• Employees training in the use of emergencyequipment	• Contractorduringconstructionand decommissioningphases. • Proponentduringoperationphase.

FirstAid	• Provisionoffirstaidkits, • Firstaidmanagementtraining	• Contractorduringconstructionand decommissioningphases. • Proponentduringoperationphase.
Signage	• Firesensors • Signage,actionposter,alarmbell/panic button	• Contractorduringconstructionand decommissioningphases. • Proponentduringoperationphase.
Procedurefor Rescueand evacuation	• Evacuationplan, • Warningsystem, • Assemblysite • Shelterinplaceplan.	• Contractorduringconstruction and decommissioningphases. • Proponentduringoperationphase.
Occupants emergency contact information	• Listofalloccupants,residents&their activities	• Proponentduringoperationphase.
ERPreview	• AnnualERPreview	• Contractorduringconstruction and decommissioningphases. • Proponentduringoperationphase.

General Procedures for Spill Cleanup

- Determine the nature and the extent of the spill—what has been spilled (i.e., the chemical or biological agent), its concentration, quantity, and location.
- Evacuate the area immediately (if necessary to prevent exposure of additional persons to a particularly toxic or virulent agent).
- Provide immediate medical treatment to those exposed (if warranted by the nature of the exposure).
- Secure and post the spill area to prevent additional exposures and spread of the spill.
- Put on appropriate personal protective equipment (PPE).
  - ☑ Always: glasses, gloves, lab coat or apron, shoe coverings.
  - ☑ As appropriate (depending on the nature of the spill): face shield or goggles, respirator, boots.
- Contain the spill (e.g., by dyking or ringing with absorbent material).
- Decontaminate the spilled material if warranted (i.e., it is often prudent to decontaminate the spilled material before it is picked up). Disinfect using 10% bleach solution or another approved disinfectant (see section 10.6) for a thirty-minute contact time.
- Pick up the spilled material:

A. Solids:
   - Pick up by mechanical means (e.g., pan and brush, forceps).
   - Discard as medical, hazardous, or radioactive waste as appropriate.

B. Liquids:
   - Absorb the spill with absorbent material as appropriate (e.g., paper towels, vermiculite).
   - Discard as medical, hazardous, or radioactive waste as appropriate.

C. Broken glass and other sharps:
   - Pick up by mechanical means (e.g., forceps, pan and brush), never by hand.
   - Dispose as sharps.

- Decontaminate the area using an appropriate disinfectant
- Rinse/clean the area (if necessary) and absorb and collect waste materials.

- Dispose of collected material and cleanup materials as medical, hazardous, or radioactive waste as appropriate.
- Decontaminate reusable items (such as dust pans, brushes, and forceps).
- Remove personal protective equipment (PPE).
    - Discard disposable items as medical, hazardous, or radioactive waste as appropriate.
    - Decontaminate reusable items (such as heavy rubber gloves, boots, aprons, gowns) before cleaning or laundering.
- Wash all exposed skin thoroughly.
- Perform medical treatment and follow up as appropriate for the particular type of material.

AnnexV: Inspection Checklist for BSL-3 Laboratories (BMBL 5th Edition)

Statement	Response			Comments
	Yes	No	N/A	
The laboratory supervisor must enforce the institutional policies that control access to the laboratory.	○	○	○	
Persons must wash their hands after working with potentially hazardous materials and before leaving the laboratory.	○	○	○	
Eating, drinking, smoking, handling contact lenses, applying cosmetics, and storing food for human consumption must not be permitted in laboratory areas.	○	○	○	
Food must be stored outside the laboratory area in cabinets or refrigerators designated and used for this purpose.	○	○	○	
Mouth pipetting is prohibited; mechanical pipetting devices must be used.	○	○	○	
Policies for the safe handling of sharps, such as needles, scalpels, pipettes, and broken glassware must be developed and implemented.	○	○	○	
Whenever practical, laboratory supervisors should adopt improved engineering and work practice controls that reduce risk of sharps injuries.	○	○	○	
Precautions, including those listed below, must always be taken with sharp items. These include:	○	○	○	
Careful management of needles and other sharps are of primary importance. Needles must not be bent, sheared, broken, recapped, removed from disposable syringes, or otherwise manipulated by hand before disposal.	○	○	○	
Used disposable needles and syringes must be carefully placed in conveniently located puncture-resistant containers used for sharps disposal.	○	○	○	
Non-disposable sharps must be placed in a hard walled container for transport to a processing area for decontamination, preferably by autoclaving.	○	○	○	
Broken glassware must not be handled directly. Instead, it must be removed using a brush and dustpan, tongs, or forceps.	○	○	○	
Plasticware should be substituted for glassware whenever possible.	○	○	○	
Perform all procedures to minimize the creation of splashes and/or aerosols.	○	○	○	

Minster of Health Certificate of Titled Deed (Land ownership certificate)

Annex VI: Legal Documents of the consulting firm

ቁጥር :11/1.1/7042/14
ቀን : 4/6/2014

የብቃት ማረጋገጫ የምስክር ወረቀት

የአካባቢ ጥበቃ ባለስልጣን የአካባቢ እና ማኅበረሰብ ተፅዕኖ ግምገማ ጥናት የማማከር አገልግሎት ብቃት ማረጋገጫ ምስክር ወረቀት አሰጣጥ መመሪያ ቁጥር 03/2010 መሠረት ለባዛል ኮንሰልቲንግ በአካባቢ እና ማኅበረሰብ ተፅዕኖ ግምገማ ጥናት የማማከር አገልግሎት ላይ ደረጃ 1 የብቃት ማረጋገጫ ምስክር ወረቀት ሰጥቷል። የባለሙያዎቹ ዝርዝር ተያይዟል።

ከሠላምታ ጋር

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የአካባቢና ማህበረሰብ ተፅዕኖ ግምገማና
የአካባቢ ፍቃድ መስጠት
ዳይሬክተር ጀነራል

Ref No : 11/1.1/7042/14
Date : 11/2/2022

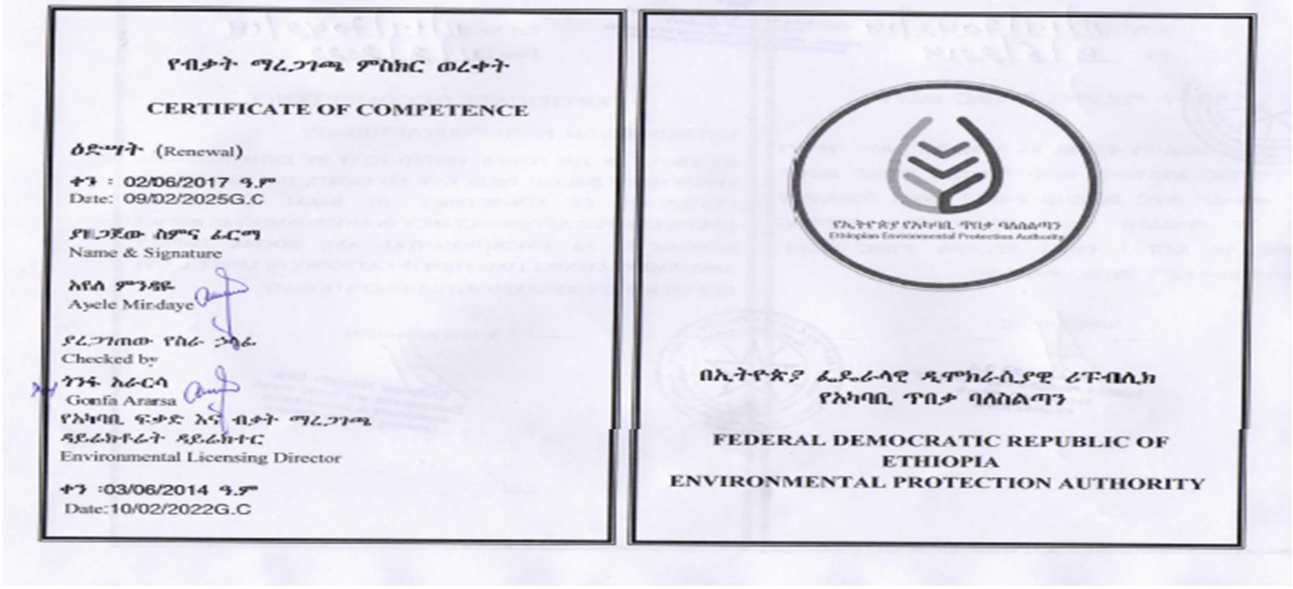
CERTIFICATE OF COMPETENCE

ENVIRONMENTAL PROTECTION AUTHORITY

BY VIRTUE OF THE POWER VESTED TO IT BY ENVIRONMENTAL COMPETENCE ISSUING DIRECTIVE NO **03/2017**, HAS ISSUED THIS CERTIFICATE OF COMPETENCE TO **BASAL CONSULTING ENGINEERS PLC** AS CONSULTANCY IN ENVIRONMENTAL IMPACT ASSESSMENT AS **ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT CONSULTING FIRM IN** CATEGORY OF **LEVEL 1.** LIST OF EXPERTS ARE ANNEXED WITH THIS CERTIFICATE.

WITH REGARDS

Shiferaw Negash Bira
Environmental and Social Impact Assessment & Environmental Licensing Director General



የብቃት ማረጋገጫ ምስክር ወረቀት

CERTIFICATE OF COMPETENCE

ዕድሣት (Renewal)

ቀን : 02/06/2017 ዓ.ም
Date: 09/02/2025G.C

ያዘጋጀው ስምና ፊርማ
Name & Signature

አየለ ምንዳዬ
Ayele Mirdaye

ያረጋገጠው የስራ ኃላፊ
Checked by

ጎንፋ አራርሳ
Gonfa Ararsa
የአካባቢ ፍቃድ እና ብቃት ማረጋገጫ
ዳይሬክቶሬት ዳይሬክተር
Environmental Licensing Director

ቀን :03/06/2014 ዓ.ም
Date:10/02/2022G.C

የኢትዮጵያ የአካባቢ ጥበቃ ባለስልጣን
Ethiopian Environmental Protection Authority

በኢትዮጵያ ፌዴራላዊ ዲሞክራሲያዊ ሪፑብሊክ
የአካባቢ ጥበቃ ባለስልጣን

FEDERAL DEMOCRATIC REPUBLIC OF ETHIOPIA
ENVIRONMENTAL PROTECTION AUTHORITY

ቁጥር: ዘ/ተ/1/3041/14

ቀን: 03/06/2014 ዓ.ም

ለባሳል ኮንሰልቲንግ የማማከር አገልግሎት በአካባቢ እና ማህበራዊ ተፅዕኖ ጥናት ዘርፍ የአማሪ ድርጅት የባለሙያዎች ዝርዝር

ተ/ቁ	የባለሙያዎች ስም	ደረጃ	የሚያማክሩበት ሙያ	ስልክ	ፈሚነት
1	አቶ ሀብታሙ ማስረሻ	ከፍተኛ አማካሪ	የመቶት አማቂ ጋዝ ልቀት ተንታኝ ባለሙያ	0930285738	ሥራ አስኪያጅ
2	አቶ ማስረሻ ቀየ ሰው	ከፍተኛ አማካሪ	የኢኮኖሚ ጉዳዮች ተንታኝ ባለሙያ	0911549357	
3	አቶ የሽዋስ ጥጋቡ	ከፍተኛ አማካሪ	የማህበራዊ ጉዳዮች ተንታኝ ባለሙያ	0920215788	✓
4	አቶ መኮንን ጌታሁን	ከፍተኛ አማካሪ	የአካባቢ ጤና ተንታኝ ባለሙያ	0912021D16	
5	ዶ/ር ማህሰኝ ጌታቸው	ከፍተኛ አማካሪ	የብዝሐ ሕይወት እና የስርዓተ-ምህዳር ተንታኝ ባለሙያ	0912865113	
6	ዶ/ር አስፋ ተክሌ	መካከለኛ አማካሪ	የውሃ ሀብት አጠቃቀም አዋኒ ባለሙያ	0921529218	
7	አቶ ሶሪ ሚልቺሳ	ከፍተኛ አማካሪ	የአካባቢ ብክለት ተንታኝ ባለሙያ	0912830933	

ከሰላምታ ጋር

የንግድ ስም ምሥክር ወረቀት ቁ 0042863148

የንግድ ምዝገባ ቁጥር 10-314/2007

የንግድ ሥራ ፈቃድ ቁጥር 10-16/2008

በአማራ ብሔራዊ ክልላዊ መንግስት

የንግድና ትራንስፖርት ቢሮ

የንግድ ስም ምዝገባ ምስክር ወረቀት

በንግድ ሥራ ምዝገባና ፈቃድ አዋጅ ቁጥር 686/2002 መሠረት የተሰጠ

1 ሥም ሸዳዮማው ሽአዮማ ቢደጋ

2. የንግድ ቅና ዘርፍ መደብ ያለንበረ አደ-ንስቃመጠት

3 የፈቃድ መስጫ መደብ 88222

4 የንግድ ሥራው አድራሻ

ክልል አማራ ዞንስተማ አስተዳደር ደብረወሎ ወረዳ ደብረ ከተማ ደንጋጣ ቀበሌ 10 የቤት ቁጥር ፐB41-43

ስልክ ቁጥር 0930285738 ፖ.ሣ.ቁ ---------- ፋክስ ----------

5 የንግድ ስም "ባዛልኮንሰልቲንግ" / BASAL CONSULTING

6 ከላይ የተሰጠው የንግድ ስም በአዋጅ ቁጥር 686/2002 አንቀጽ 24 መሠረት የአመልካቹ/ክ/ት የንግድ ስም ተደርጎ የተመዘገበ መሆኑን እናረጋግጣለን።

ይህ የምዝገባና የምስክር ወረቀት ዛሬ 05/05 ቀን 200 ም ዓ/ም በ ደንጋጣ ከተማ ተሰጠ

የንግድ ምዝገባና ፅድሳት ኦፊሰር ስም ሽለማቱ መንግስቱ ፊርማ

ማሳሰቢያ፣ በንግድ ስሙ ላይ ማናቸውም መሻሻል በሚደረግበት ጊዜ በሁለት ወራት ጊዜ ውስጥ መስተካከል አለበት።

በአማራ ብሔራዊ ክልላዊ መንግስት ንግድና ገበያ ልማት ቢሮ

Amhara National Regional State Trade and Market Development Bureau

የግብር ከፋይ መለያ ቁ. /TIN 0042863148

የንግድ ምዝገባ ቁ . AM/DES/BW/1/0000049/2008
Principal Registration No.

የቀድሞው ንግድ ፈቃድ ቁጥር 016/07
Previous License No.

የንግድ ሥራ ፈቃድ ቁጥር AM/DES/BW/03/137/5945047/2008
Business License No.

ቀድሞ ተሰጠበት ቀን 27/9/2007
Previous Date of issuance

የተሰጠበት ቀን 3/2/2008
Date of issuance

የታደሰበት ቀን : 21/3/2015

የንግድ ሥራ ፈቃድ

በንግድ ምዝገባና ፈቃድ አዋጅ ቁጥር 980/2008 መሰረት ተሰጠ

1. የግለሰቡ/ድርጅቱ ስም ሰማዉ አስማረ ቢያድጌ

2. ዜግነት ኢትዮጵያዊ

3. የንግድ ስም

4. ሥራ አስኪያጅ ስም አቶ ሰማዉ አስማረ ቢያድጌ

5. የንግድ ድርጅቱ አድራሻ

ክልል አማራ ዞን/ክፍለ ከተማ ደሴ ከተማ
ወረዳ ቧንቧሃ ቀበሌ KEBELE 10
የቤት ቁጥር tb41-43 ስልክ ቁጥር 0913436142
ፋክስ ኢ-ሜይል

6. የንግድ ሥራ መስክ

(86312)በአካባቢ ኦዲትና አካባቢ አጠባበቅ የማማከር አገልግሎት, (86311)በጤና የማማከር አገልግሎት

7. ካፒታል በኢት ብር 558,586

ይህ የንግድ ፈቃድ ዛሬ 24/3/2015 በ አማራ ተሰጠ

የሃላፊ ስም/Name of Official
ፊርማ/Signature

ማህተም Seal

Business License

Issued Under Commercial Registration and Business license proc.No 980/2016

1. Owner/Company Name SEMAW ASMARE BIYADGIE

2. Nationality Ethiopian

3. Trade Name

4. General Manager Name Mr. SEMAW ASMARE BIYADGIE

5. Business Address

Region Amhara Zone/Sub City DESSIE CITY
Woreda Banbuha Kebele KEBELE 10
House No. tb41-43 Tel.No 0913436142
Fax E-mail

6. Field of Business

(86312)Environmental auditing and environmental protection consultancy service , (86311)Health consultancy service

7. Capital in ETB 558,586

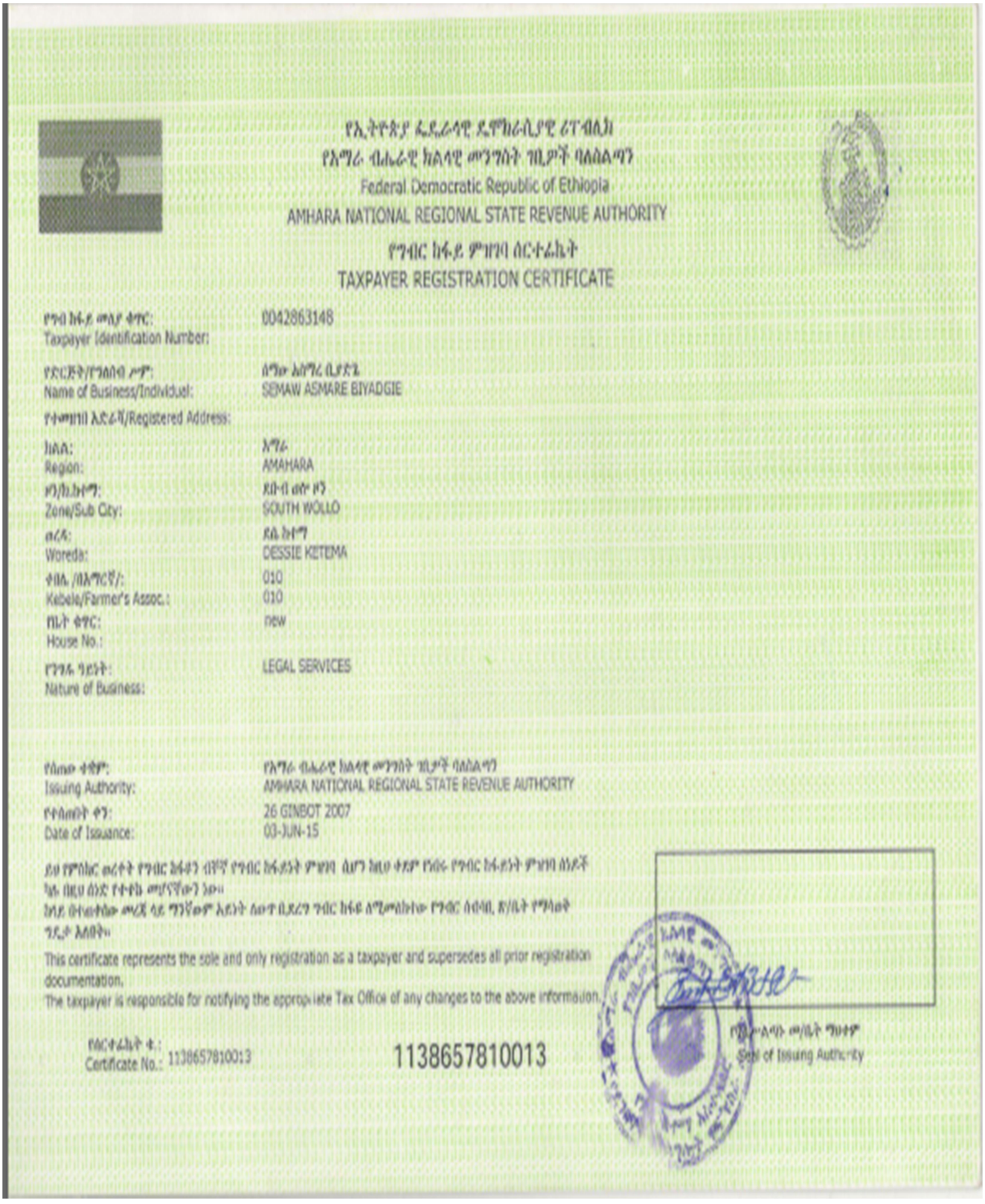
This Business License is issued in Amhara this day 12/3/2022

ለ 2015 ታድሷል

ማሳሰቢያ- N.B.

1. ይህ የንግድ ፍቃድ በዓዋጅ ፈቃድ ቁጥር 980/2008 መሠረት እንደ የበጀት ዓመቱ በአዋጅ በተቀመጠው መሰረት መታደስ አለበት።
This License Shall be renewed in accordance with Proclamation No. 980/2008 as per the fiscal year.

2. ይህ የንግድ ፈቃድ የምስክር ወረቀት በዋስትና ወይም በእዳ ሊያዝ አይችልም።
The holder of this License is forbidden for surety ship or debt



የኢትዮጵያ ፌደራላዊ ዴሞክራሲያዊ ሪፐብሊክ
የአማራ ብሔራዊ ክልላዊ መንግስት ገቢዎች ባለስልጣን
Federal Democratic Republic of Ethiopia
AMHARA NATIONAL REGIONAL STATE REVENUE AUTHORITY

የግብር ከፋይ ምዝገባ ሰርተፊኬት
TAXPAYER REGISTRATION CERTIFICATE

የግብ ከፋይ መለያ ቁጥር: 0042863148
Taxpayer Identification Number:

የድርጅት/የግለሰብ ሥም: ሰማው አስማረ ቢያድጌ
Name of Business/Individual: SEMAW ASMARE BIYADGIE

የተመዘገበ አድራሻ/Registered Address:

ክልል: አማራ
Region: AMAHARA

ዞን/ክ/ከተማ: ደቡብ ወሎ ዞን
Zone/Sub City: SOUTH WOLLO

ወረዳ: ደሴ ከተማ
Woreda: DESSIE KETEMA

ቀበሌ /በአምርቾ/: 010
Kebele/Farmer's Assoc.: 010

የቤት ቁጥር: new
House No.:

የንግዱ ዓይነት: LEGAL SERVICES
Nature of Business:

የሰጠው ተቋም: የአማራ ብሔራዊ ክልላዊ መንግስት ገቢዎች ባለስልጣን
Issuing Authority: AMHARA NATIONAL REGIONAL STATE REVENUE AUTHORITY

የተሰጠበት ቀን: 26 GINBOT 2007
Date of Issuance: 03-JUN-15

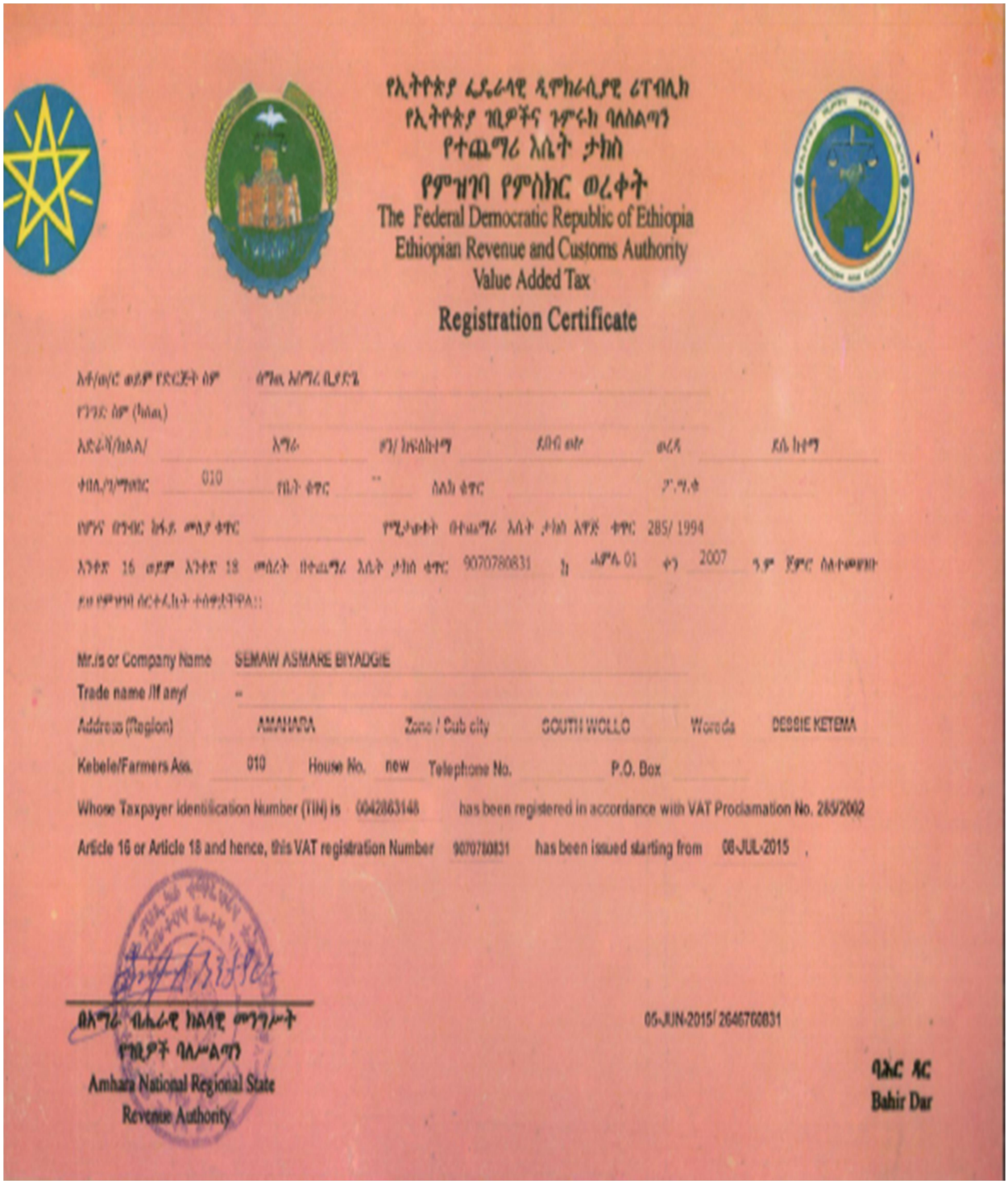
ይህ የምስክር ወረቀት የግብር ከፋዩን ብቸኛ የግብር ከፋይነት ምዝገባ ሲሆን ከዚህ ቀደም የነበሩ የግብር ከፋይነት ምዝገባ ሰነዶች ካሉ በዚህ ሰነድ የተተኩ መሆናቸውን ነው።
ከላይ በተጠቀሰው መረጃ ላይ ማንኛውም አይነት ለውጥ ቢደረግ ግብር ከፋይ ለሚመለከተው የግብር ሰብሳቢ ጽ/ቤት የማሳወቅ ግዴታ አለበት።

This certificate represents the sole and only registration as a taxpayer and supersedes all prior registration documentation.
The taxpayer is responsible for notifying the appropriate Tax Office of any changes to the above information.

የሰርተፊኬት ቁ.: 1138657810013
Certificate No.:

1138657810013

የሚሰጥ ሰላጣን መ/ቤት ማህተም
Seal of Issuing Authority



የኢትዮጵያ ፌዴራላዊ ዲሞክራሲያዊ ሪፐብሊክ
የኢትዮጵያ ገቢዎችና ጉምሩክ ባለስልጣን
የተጨማሪ እሴት ታክስ

የምዝገባ የምስክር ወረቀት

The Federal Democratic Republic of Ethiopia
Ethiopian Revenue and Customs Authority
Value Added Tax

Registration Certificate

አቶ/ወ/ሮ ወይም የድርጅት ስም ሰማኒ አስማረ ቢያድጌ

የንግድ ስም (ካለዉ)

አድራሻ/ክልል/ አማራ ዞን/ ክፍለከተማ ደቡብ ወሎ ወረዳ ደሴ ከተማ

ቀበሌ/ባ/ማኅበር 010 የቤት ቁጥር -- ስልክ ቁጥር ፖ.ሳ.ቁ

ከሆነ በግብር ክፍያ መለያ ቁጥር የሚታወቁት በተጨማሪ እሴት ታክስ እዋጅ ቁጥር 285/ 1994

አንቀጽ 16 ወይም አንቀጽ 18 መሰረት በተጨማሪ እሴት ታክስ ቁጥር 9070780831 ነሐ ሐምሌ 01 ቀን 2007 ጀምሮ ስለተመዘገቡ
ይህ የምዝገባ ሰርተፊኬት ተሰጥቶዎታል::

Mr./s or Company Name SEMAW ASMARE BIYADGIE

Trade name /If any/ -

Address (Region) AMHARA Zone / Sub city SOUTH WOLLO Woreda DESSIE KETEMA

Kebele/Farmers Ass. 010 House No. new Telephone No. P.O. Box

Whose Taxpayer identification Number (TIN) is 0042863148 has been registered in accordance with VAT Proclamation No. 285/2002

Article 16 or Article 18 and hence, this VAT registration Number 9070780831 has been issued starting from 08-JUL-2015 .

በአማራ ብሔራዊ ክልላዊ መንግሥት
የገቢዎች ባለሥልጣን
Amhara National Regional State
Revenue Authority

05-JUN-2015/ 26467600831

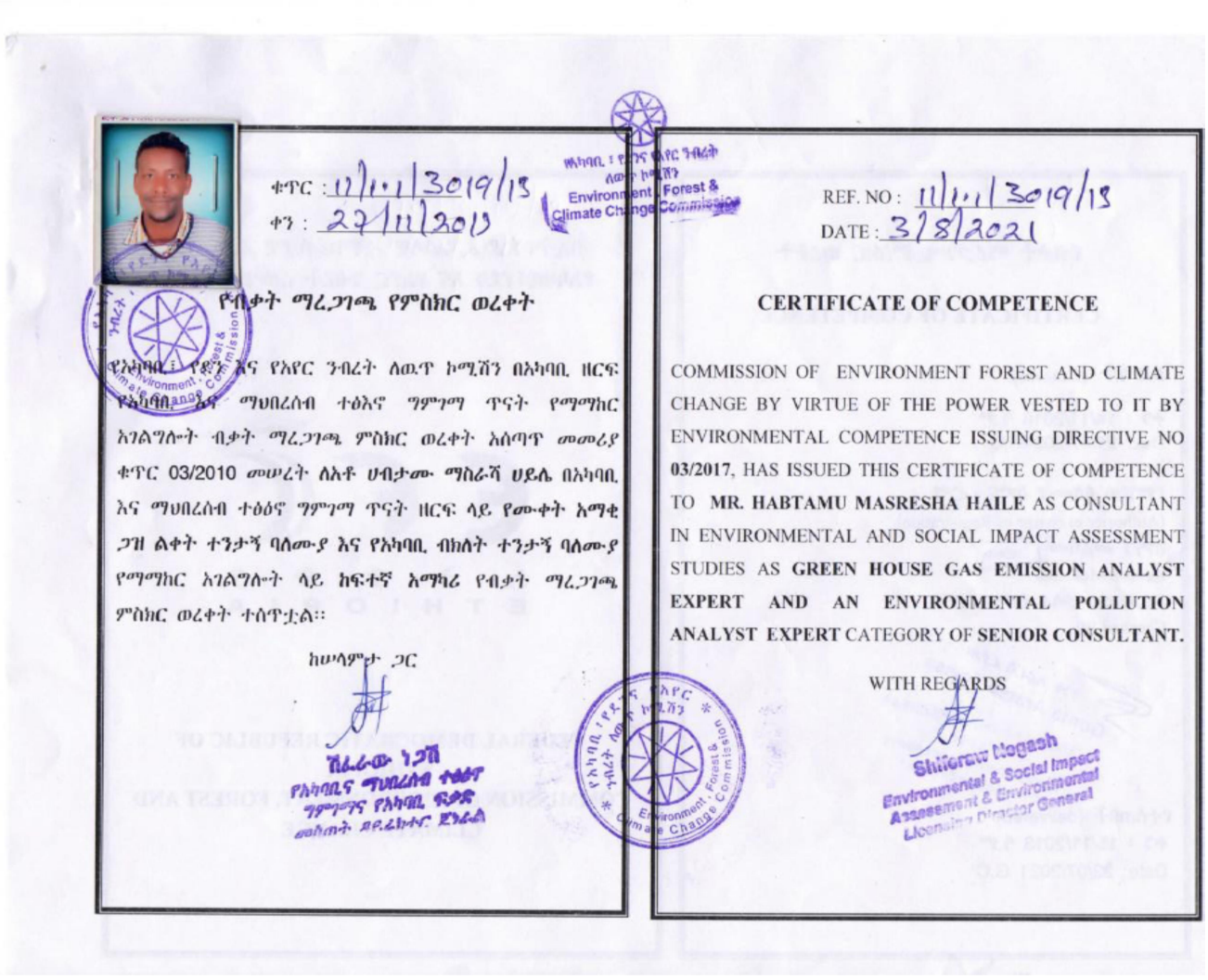
ባሕር ዳር
Bahir Dar

Annex VII: Cv And Competency Certificate of Consultants

1. Mr.Habtamu Masresha (Greenhouse gas emission control expert)

1.1 Personal Data

- Full name: Habtamu Masresha (Greenhouse gas emission control expert)
- Marital status: Married
- Age: 34
- Mailing address: habtamumar@gmail.com
- Permanent address: AA, Ethiopia
- Mobile: +251-921964514



የብቃት ማረጋገጫ የምስክር ወረቀት

የአካባቢ፣ የደንና የአየር ንብረት ለዉጥ ኮሚሽን በአካባቢ ዘርፍ የአካባቢ እና ማህበረሰብ ተፅእኖ ግምገማ ጥናት የማማከር አገልግሎት ብቃት ማረጋገጫ ምስክር ወረቀት አሰጣጥ መመሪያ ቁጥር 03/2010 መሠረት ለአቶ ሀብታሙ ማስራሻ ሀይሌ በአካባቢ እና ማህበረሰብ ተፅዕኖ ግምገማ ጥናት ዘርፍ ላይ የሙቀት አማቂ ጋዝ ልቀት ተንታኝ ባለሙያ እና የአካባቢ ብክለት ተንታኝ ባለሙያ የማማከር አገልግሎት ላይ ከፍተኛ አማካሪ የብቃት ማረጋገጫ ምስክር ወረቀት ተሰጥቷል።

ከሠላምታ ጋር

CERTIFICATE OF COMPETENCE

COMMISSION OF ENVIRONMENT FOREST AND CLIMATE CHANGE BY VIRTUE OF THE POWER VESTED TO IT BY ENVIRONMENTAL COMPETENCE ISSUING DIRECTIVE NO 03/2017, HAS ISSUED THIS CERTIFICATE OF COMPETENCE TO MR. HABTAMU MASRESHA HAILE AS CONSULTANT IN ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT STUDIES AS GREEN HOUSE GAS EMISSION ANALYST EXPERT AND AN ENVIRONMENTAL POLLUTION ANALYST EXPERT CATEGORY OF SENIOR CONSULTANT.

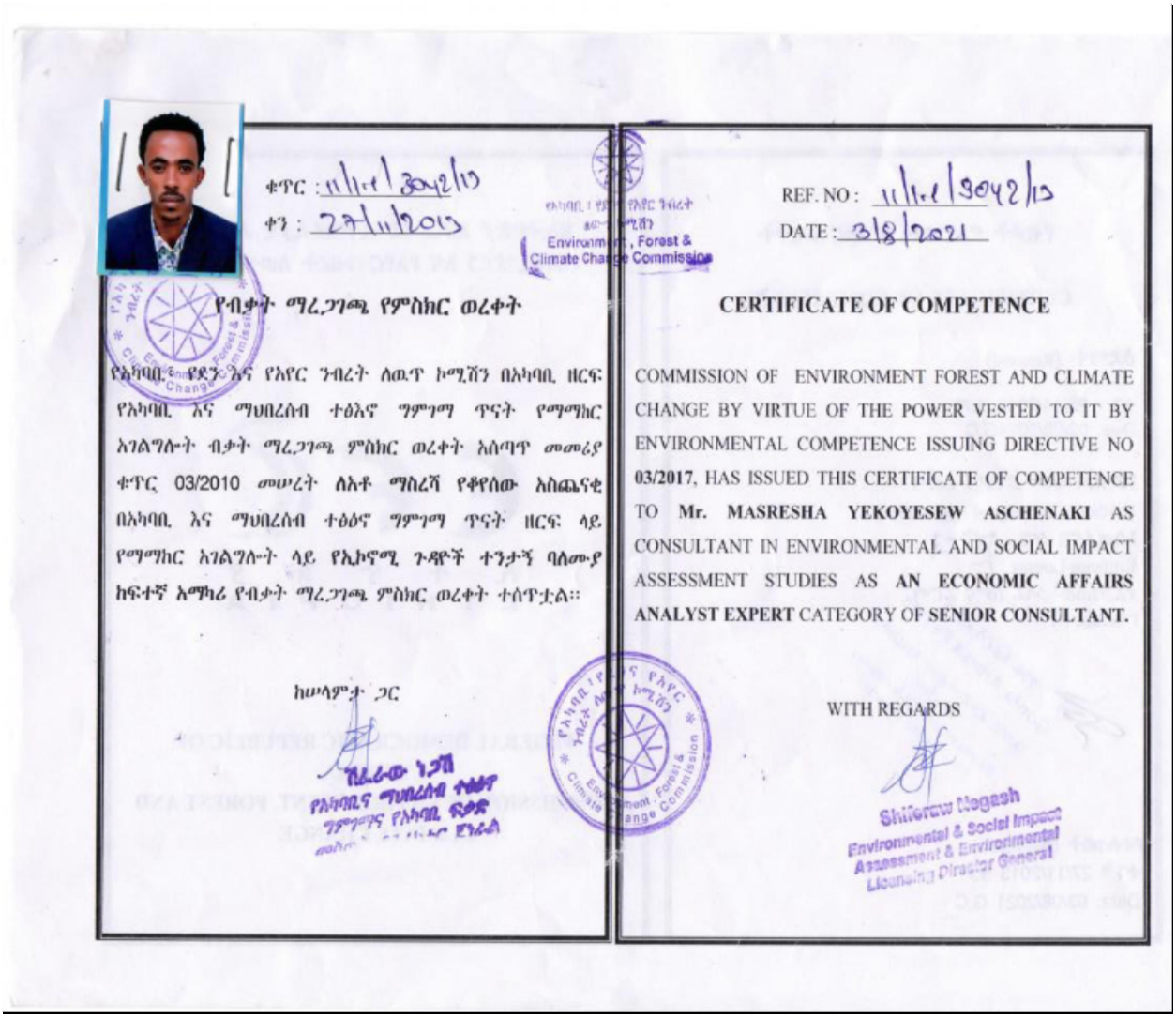
WITH REGARDS

2. Mr.Masresha Yekoyesew (MSc, Economic Expert)

2.1 Personal Data

- Full name: Masresha Yekoyesew (Ecoonomic expert)

- Marital status: Single
- Age: 35
- Mailing address: masreshayekoyesew93@gmail.com
- Permanent address: Debrebirhan, Ethiopia
- Mobile: +251-912847366



የብቃት ማረጋገጫ የምስክር ወረቀት

የአካባቢ፣ የደን እና የአየር ንብረት ለዉጥ ኮሚሽን በአካባቢ ዘርፍ የአካባቢ እና ማህበረሰብ ተፅእኖ ግምገማ ጥናት የማማከር አገልግሎት ብቃት ማረጋገጫ ምስክር ወረቀት አሰጣጥ መመሪያ ቁጥር 03/2010 መሠረት ለአቶ ማስረሻ የቀየሰው አስጨናቂ በአካባቢ እና ማህበረሰብ ተፅዕኖ ግምገማ ጥናት ዘርፍ ላይ የማማከር አገልግሎት ላይ የኢኮኖሚ ጉዳዮች ተንታኝ ባለሙያ ከፍተኛ አማካሪ የብቃት ማረጋገጫ ምስክር ወረቀት ተሰጥቷል።

ከሠላምታ ጋር

CERTIFICATE OF COMPETENCE

COMMISSION OF ENVIRONMENT FOREST AND CLIMATE CHANGE BY VIRTUE OF THE POWER VESTED TO IT BY ENVIRONMENTAL COMPETENCE ISSUING DIRECTIVE NO **03/2017**, HAS ISSUED THIS CERTIFICATE OF COMPETENCE TO **Mr. MASRESHA YEKOYESEW ASCHENAKI** AS CONSULTANT IN ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT STUDIES AS **AN ECONOMIC AFFAIRS ANALYST EXPERT** CATEGORY OF **SENIOR CONSULTANT.**

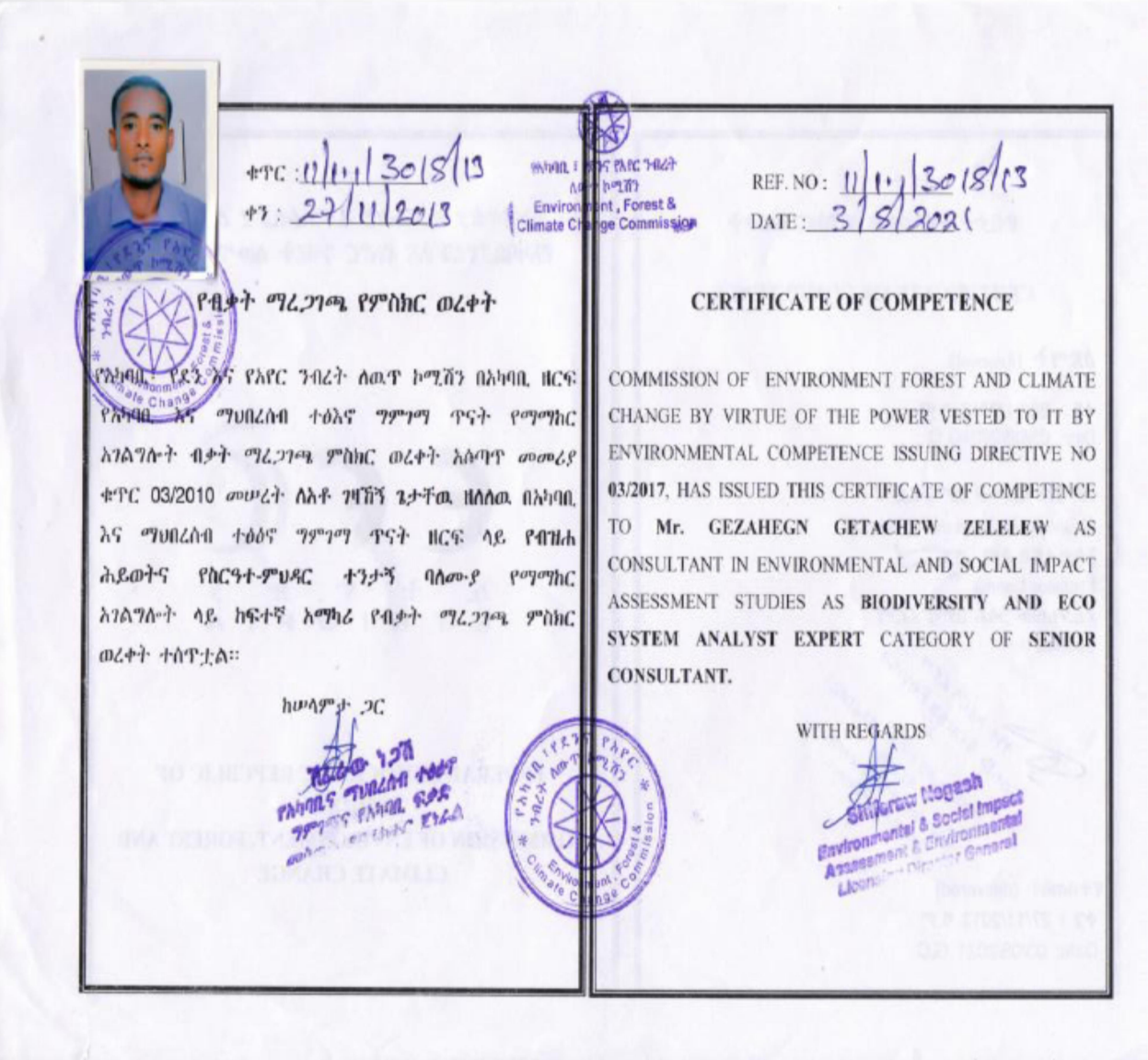
WITH REGARDS

Shiferaw Negash
Environmental & Social Impact Assessment & Environmental Licensing Director General

3. Dr. Gezahegn Getachew **Zelelew** (PhD, MSc, Ecology, Biodiversity Expert)

3.1 Personal Data

- Full name: Gezahegn Getachew Zelelew
- Marital status: Married
- Age:
- Mailing address: geze89@yahoo.com
- Permanent address: Wollo University, Dessie, Ethiopia
- Mobile: +251-912865113



የብቃት ማረጋገጫ የምስክር ወረቀት

የአካባቢ፣ የደን እና የአየር ንብረት ለዉጥ ኮሚሽን በአካባቢ ዘርፍ፣ የአካባቢ እና ማህበረሰብ ተፅእኖ ግምገማ ጥናት የማማክር አገልግሎት ብቃት ማረጋገጫ ምስክር ወረቀት አሰጣጥ መመሪያ ቁጥር 03/2010 መሠረት ለአቶ ገዛኸኝ ጌታቸዉ ዘለለዉ በአካባቢ እና ማህበረሰብ ተፅዕኖ ግምገማ ጥናት ዘርፍ ላይ የብዝሐ ሕይወትና የስርዓተ-ምህዳር ተንታኝ ባለሙያ የማማክር አገልግሎት ላይ ከፍተኛ አማካሪ የብቃት ማረጋገጫ ምስክር ወረቀት ተሰጥቷል።

ከሠላምታ ጋር

CERTIFICATE OF COMPETENCE

COMMISSION OF ENVIRONMENT FOREST AND CLIMATE CHANGE BY VIRTUE OF THE POWER VESTED TO IT BY ENVIRONMENTAL COMPETENCE ISSUING DIRECTIVE NO 03/2017, HAS ISSUED THIS CERTIFICATE OF COMPETENCE TO Mr. GEZAHEGN GETACHEW ZELELEW AS CONSULTANT IN ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT STUDIES AS BIODIVERSITY AND ECO SYSTEM ANALYST EXPERT CATEGORY OF SENIOR CONSULTANT.

WITH REGARDS

4. Mr.Sori Chalchisa Dibaba (M.A in Development Studies (Environment and Development))

4.1 Personal Data

- **Full Name:** **Mr. Sori Chalchisa (Environmental pollution Analyst)**
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- Mailing address: soribs2000@gmail.com/ soribs2000@yahoo.com
- Permanent address: Addis Ababa, Ethiopia

- Mobile: +251912-8309

ቁጥር 11/1/4850/14
ቀን : 9/2/2014

የብቃት ማረጋገጫ የምስክር ወረቀት

የአካባቢ ደንን እና የአየር ንብረት ለዉጥ ኮሚሽን በአካባቢ ዘርፍ የአካባቢ እና ማህበረሰብ ተፅእኖ ግምገማ ጥናት የማማከር አገልግሎት ብቃት ማረጋገጫ ምስክር ወረቀት አሰጣጥ መመሪያ ቁጥር 03/2010 መሠረት ለአቶ. ሶሪ ሻልቺሳ ዲባባ ለአካባቢ እና ማህበረሰብ ተፅዕኖ ግምገማ ጥናት ዘርፍ ላይ የማህበራዊ ጉዳዮች ተንታኝ ባለሙያ እና የአካባቢ ብክለት ተንታኝ ባለሙያ የማማከር አገልግሎት ላይ ከፍተኛ አማካሪ የብቃት ማረጋገጫ ምስክር ወረቀት ተሰጥቷል።

ከሠላምታ ጋር

ሃይሉፈራው ነጋሽ
የአካባቢና ማህበረሰብ ተፅእኖ ግምገማ እና
የአካባቢ ፍቃድ መስጠት ዳይሬክተር ጀኔራል

REF. NO : 11/1/4850/14
DATE : 19/10/2021

CERTIFICATE OF COMPETENCE

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WITH REGARDS

SHIFERAW NEGASH
Environmental and Social Impact Assessment and Environmental Licensing Director General

5. Mr.Mekonnen Getahun (Environmental health expert)

5.1 Personal Data

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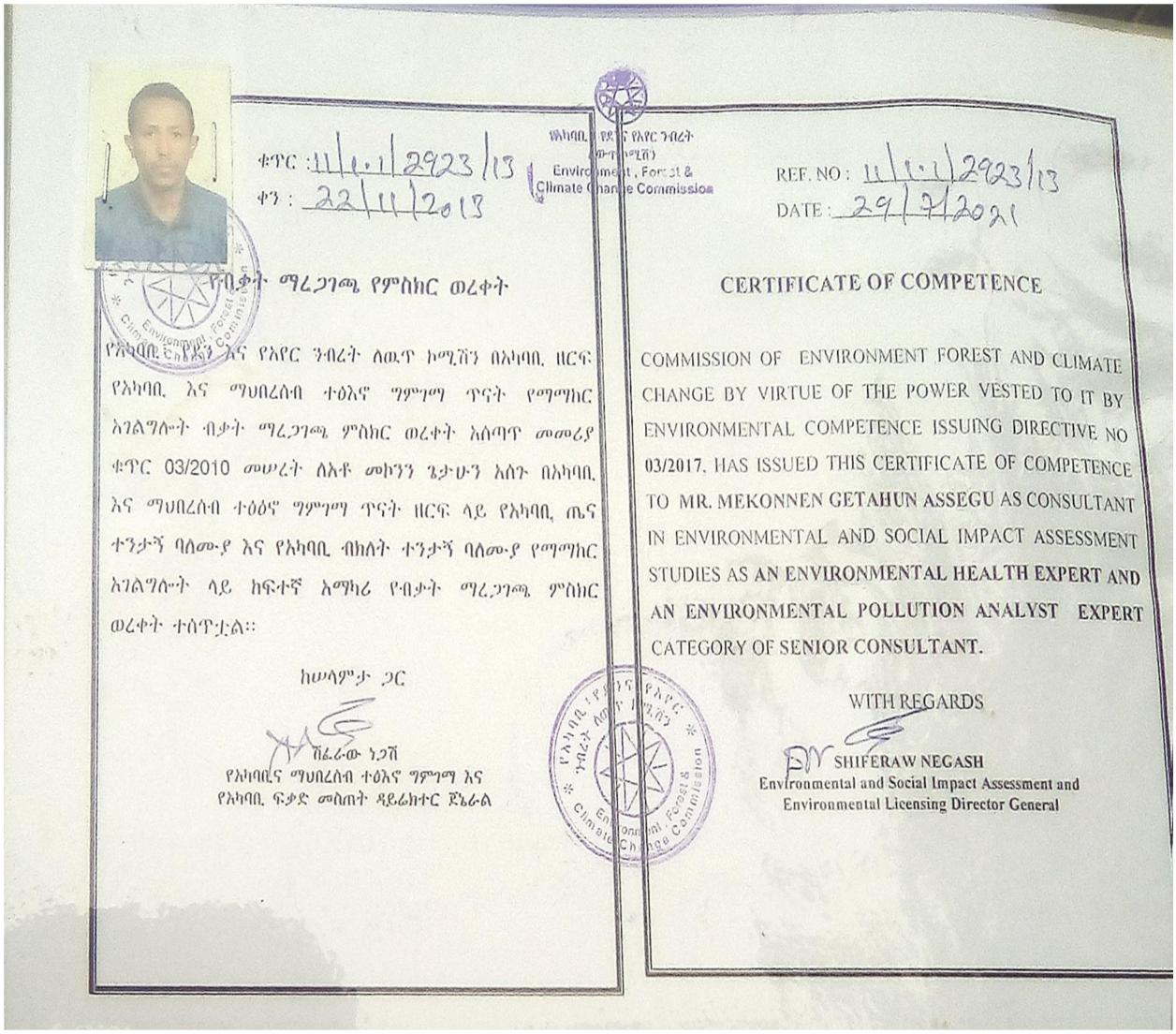
- Mailing address: yalkenu@gmail.com
- Permanent address: Dessie, Ethiopia
- Mobile: +251 912 021016



ቁጥር :11/1.1/2923/13
ቀን : 22/11/2013

የአካባቢ ደንና የአየር ንብረት ኮሚሽን
Environment, Forest & Climate Change Commission

REF. NO : 11/1.1/2923/13
DATE : 29/7/2021

የብቃት ማረጋገጫ የምስክር ወረቀት

የአካባቢ ደንና የአየር ንብረት ለዉጥ ኮሚሽን በአካባቢ ዘርፍ የአካባቢ እና ማህበረሰብ ተዕእኖ ግምገማ ጥናት የማማከር አገልግሎት ብቃት ማረጋገጫ ምስክር ወረቀት አሰጣጥ መመሪያ ቁጥር 03/2010 መሠረት ለአቶ መኮንን ጌታሁን አሰጉ በአካባቢ እና ማህበረሰብ ተዕዕኖ ግምገማ ጥናት ዘርፍ ላይ የአካባቢ ጤና ተንታኝ ባለሙያ እና የአካባቢ ብክለት ተንታኝ ባለሙያ የማማከር አገልግሎት ላይ ከፍተኛ አማካሪ የብቃት ማረጋገጫ ምስክር ወረቀት ተሰጥቷል።

ከሠላምታ ጋር

ሽፈራው ነጋሽ
የአካባቢና ማህበረሰብ ተዕእኖ ግምገማ እና
የአካባቢ ፍቃድ መስጠት ዳይሬክተር ጀኔራል

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WITH REGARDS

SHIFERAW NEGASH
Environmental and Social Impact Assessment and
Environmental Licensing Director General

6. Dr. Assefa Tessema (Water resource use expert)

6.1. Personal data

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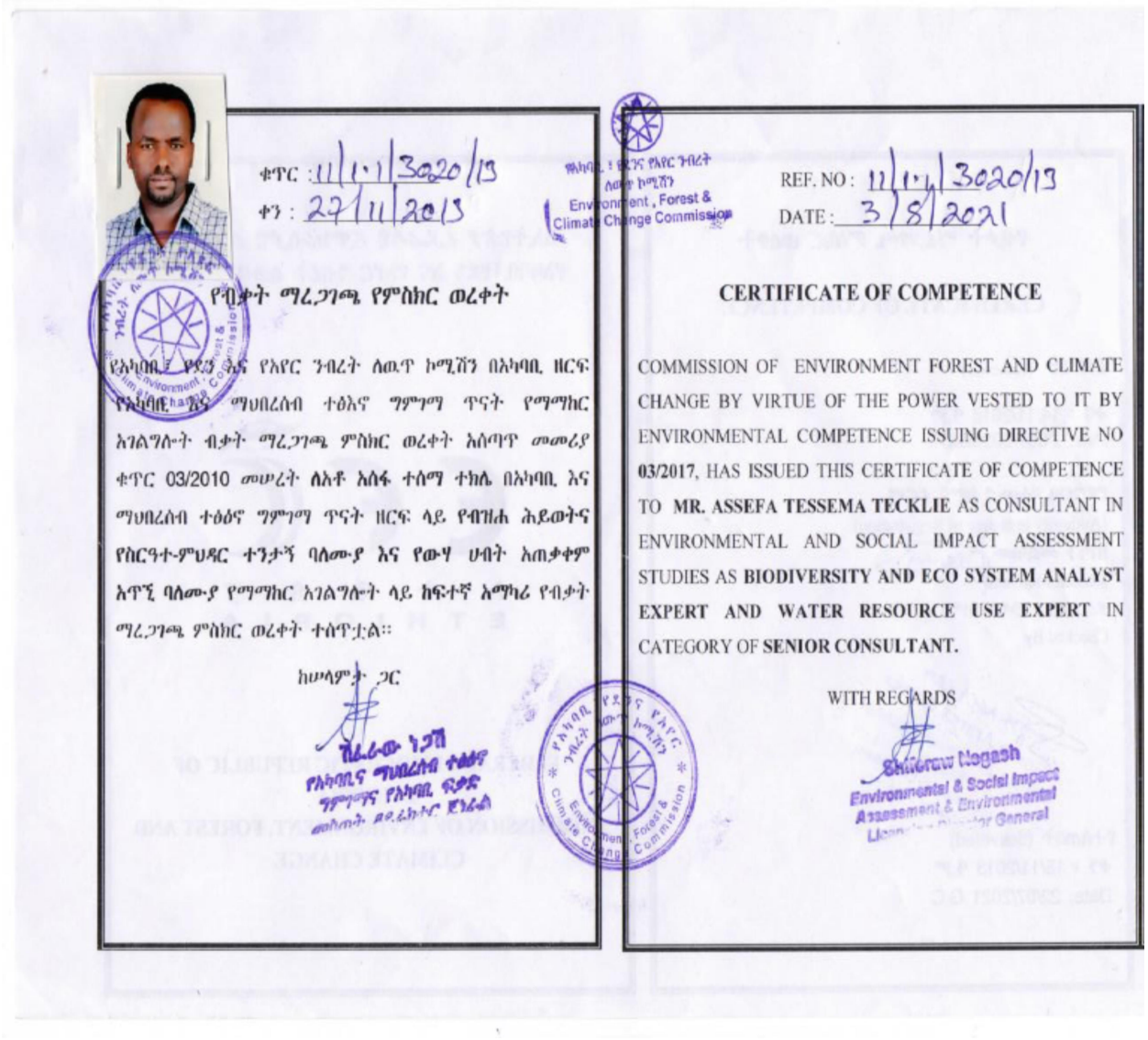
- Marital status:
- Age: 38
- Mailing address: atecklie@yahoo.com
- Permanent address: Dessie, Ethiopia
- Mobile: +251-921529218



የብቃት ማረጋገጫ የምስክር ወረቀት

የአካባቢ፣ የደንና የአየር ንብረት ለዉጥ ኮሚሽን በአካባቢ ዘርፍ የአካባቢ እና ማህበረሰብ ተፅእኖ ግምገማ ጥናት የማማከር አገልግሎት ብቃት ማረጋገጫ ምስክር ወረቀት አሰጣጥ መመሪያ ቁጥር 03/2010 መሠረት ለአቶ አሰፋ ተሰማ ተክሌ በአካባቢ እና ማህበረሰብ ተፅዕኖ ግምገማ ጥናት ዘርፍ ላይ የብዝሐ ሕይወትና የስርዓተ-ምህዳር ተንታኝ ባለሙያ እና የውሃ ሀብት አጠቃቀም አጥኚ ባለሙያ የማማከር አገልግሎት ላይ ከፍተኛ አማካሪ የብቃት ማረጋገጫ ምስክር ወረቀት ተሰጥቷል።

CERTIFICATE OF COMPETENCE

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7. Mr. Yeshiwas Tigabu (MSc, Sociologist)

7.1. Personal data

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- Marital status: Married
- Age: 30
- Mailing address: yeshikocha@gmail.com
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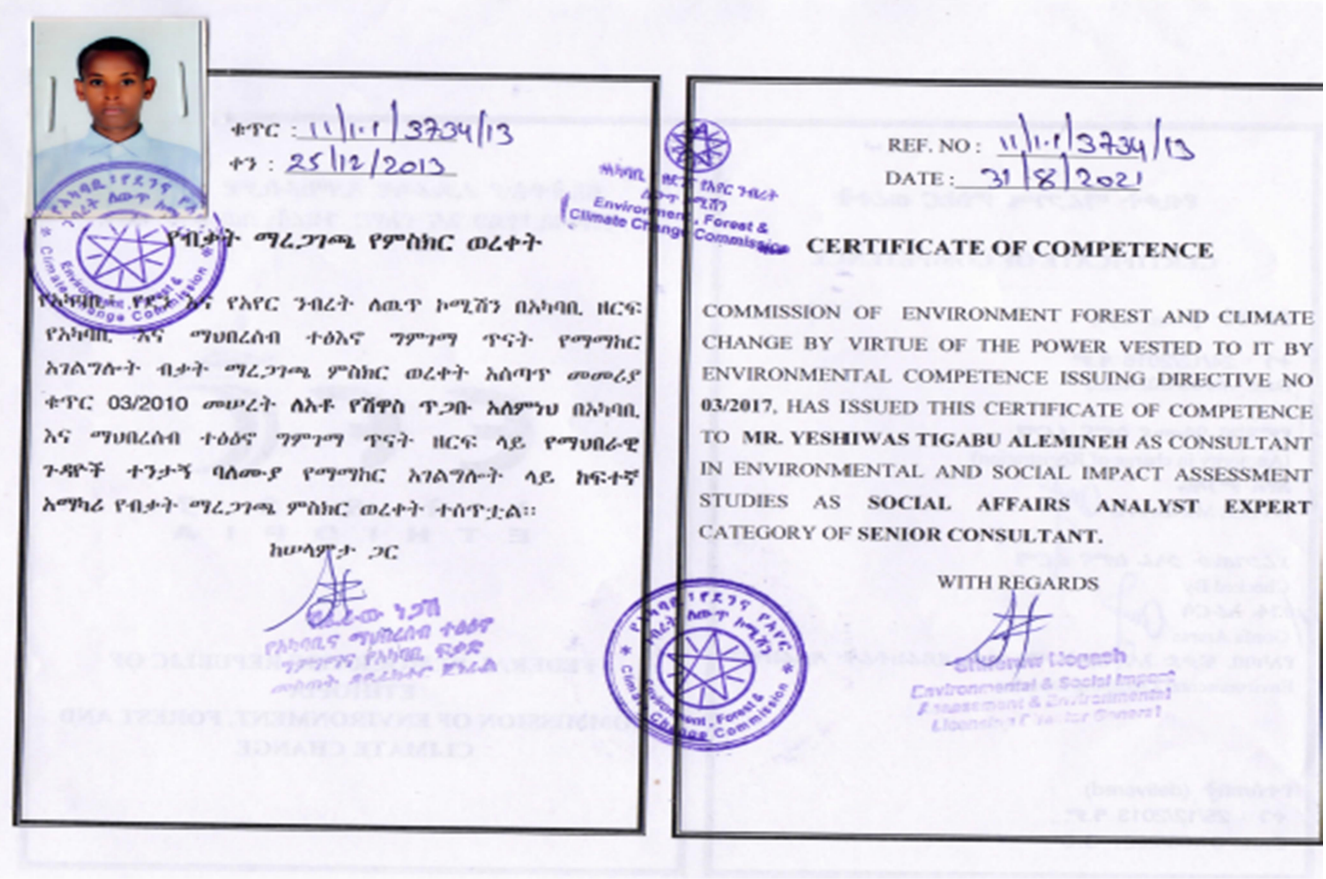
- Mobile: +251-920215788



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8 Additional Consultants

8.1 Mr. **Yohannis Fetene** (BSc, MSc, MSc) Environmental and Social Safeguard Specialist, Individual Consultant, Addis Ababa, Ethiopia.(Email: feteneyohannis@yahoo.com, Mobile: +251-924468665)