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Environmental and Social Impact Assessment

Fecal Sludge Treatment Plant Subproject for Wolaita Sodo Town

South Ethiopia Region

Second Urban Water Supply and Sanitation Project

Green Sober Environmental
Management Consultants PLC
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List of Acronyms

CDMP	Community Disease Management Plan
CEC	Code of Ethical Conduct
COB	Code of Behavior
CSE	Conservation Strategy of Ethiopia
CWIS	City Wide Inclusive Sanitation
EHSP	Environmental Health and Safety Plan
ESIA	Environmental and Social Impact Assessment
ESMF	Environmental and Social Management Framework
ESMP	Environmental and Social Management Plan
ETB	Ethiopian Birr
FDRE	Federal Democratic Republic Of Ethiopia
FEPA	Federal Environmental Protection Authority
FGDs	Focus Group Discussions
FS	Fecal Sludge
FSM	Fecal Sludge Management
FSTP	Fecal Sludge Treatment Plant
GBV	Gender based violence
HW	Hazardous Waste
HWMP	Hazards Waste management Plan
MASL	Meter above Sea Level
MSDA	Material Safety Data Sheets
OSHA	Occupational Safety and Health Administration,
PWD	People with Disability
SWMS	Solid Waste Management System
TMP	Traffic Management Plan
ToR	Terms of Reference
SER	Southern Ethiopia Region
UWSSP	Urban Water Supply and Sanitation Program
WEPO	Wolaita Environmental Protection Office
WSC	Wolaita Sodo City
WST	Wolaita Sodo Town
WSTWSSE	Wolaita Sodo Town Water Supply and Sewerage Enterprise

Executive Summary

Urban sanitation is indispensable for human health, social well-being, and economic development. It helps to prevent the spread of contagious diseases and environmental pollution through the use of improved sanitary facilities like flush toilets and fecal sludge treatment technologies. Fecal Sludge Management (FSM) is a global concern, particularly in low-income countries that predominantly rely on on-site sanitation technologies. That is why, in poor and growing urban areas of low-income countries like Ethiopia, fecal sludge management represents a growing challenge; generating significant negative public health, social wellbeing, and environmental risks.

Ethiopia is one of the Sub-Saharan African countries with poor sanitation services, and rapid urbanization is exacerbating the situation (Oliver, 2015). As a result, people in many cities and t lack access to adequate sanitation systems, consequently causing environmental and social problems (ESMF, 2017). In addition, cities and towns have increased in size and number over the past 20 years. Such trends will result in the need for more basic urban services and infrastructure in the years to come, including adequate sanitation. Meanwhile, the government of Ethiopia has set out to transform the country from a rural to urban economy-led industrialization. Meeting this goal is dependable on the cities' and towns' ability to meet urban standards of living. And one of these urban living standards is access to improved urban sanitation. Thus, the government and the World Bank have launched the second Urban Water Supply and Sanitation Program (UWSSP II).

UWSSP-II aims at increasing access to enhanced water supply and sanitation services in cities and towns of Ethiopia. The UWSSP-II is intended to aid in the government's efforts to eliminate open defecation, raise the proportion of the population using a "safely managed" sanitation service, and improve water supply services through increased operational effectiveness and expansion of water supply service to underserved areas. Therefore, the Ministry of Water and Energy (MoWE) hired Green Sober Environmental Consultant Pvt. Ltd. Co. to conduct an ESIA for the fecal sludge treatment plant (FSTP) construction project under UWSSP-II in seven towns in Ethiopia. The UWSSP-II is a five-year program co-financed by the government of Ethiopia and the World Bank.

The overall objective of the consultancy is to carry out the environmental and social impact assessment on FSTP construction in seven UWSSP-II implementing towns. The consultant is expected to identify environmental and social impacts during the life cycle of the fecal sludge treatment plants and recommend appropriate mitigation measures. Further, the consultant will prepare environmental and social management and monitoring plans.

Scope of the ESIA study: The scope of this assignment is to conduct an ESIA on the Sodo town Fecal Sludge Treatment Plant subproject activities. The major components of the ESIA include: reviewing and applying pertinent policy, legal instruments, standards and guidelines, and

institutional arrangement. The other was a collection of city-wide biophysical, socioeconomic, and cultural baseline data. Thus, an all-encompassing baseline data on soil mapping, land use and cover, water and hydrology, landscape and visual, archaeological and cultural heritage, air quality and noise, biodiversity and ecology, and socio-economic environment was collected. The stakeholder consultation and indicative household survey for the likely project-affected households were also made. The fourth scope was impact identification and development of possible mitigation measures. Finally proposal of human resources, capacity building, and monitoring plan with time and cost implications.

Methodology: The study team has chosen to use a mixed approach to produce all-inclusive baseline information. The ESIA was conducted by collecting and analyzing the socioeconomic and environmental data that have direct and indirect associations with the proposed project over survey, focus group discussions, and experimental methods. Information related to the biophysical, socio-cultural, and economic environment of the proposed project was collected exclusively on environmental safety, social acceptance, and economic viability as key points of project implementation. Moreover, data related to vulnerable groups' management, land acquisition, access to job opportunities, compensation, relocation, and infrastructure facilities were also collected and examined. The consultant was involved in the stakeholder consultation process, social and environmental surveys using structured questionnaires, and key informant interviews with the relevant institutions, lead organizations, and surrounding community representatives. Based on these findings and expert judgment, the consultant has identified and analyzed the projected social and environmental negative and likely positive impacts arising from proposed project activities. Finally, the consultant has prepared Environmental and Social Management (ESMP) and Monitoring Plans which detail how adverse impacts and risks will be reduced and by whom.

Policies, Legislations, and Institutional Framework: Relevant National Policies and Strategies, proclamations, regulations, regulatory frameworks, and the World Bank safeguard policies, WBG EHS guidelines related to the proposed project have been reviewed. The Constitution of the Federal Democratic Republic of Ethiopia (FDRE), adopted in 1995, provides the overriding principles and legal provisions for all legislative frameworks in the country. The Environmental Policy of Ethiopia, issued in 1997, has the overall policy goal to improve and enhance the health and quality of life of all Ethiopians, to promote sustainable social and economic development through sound management and use of natural, human-made, and cultural resources and their environment as a whole. ESIA policies are included in the cross-sectoral environmental policies and they emphasize the early recognition of environmental issues in project planning, public participation, mitigation and environmental management, and capacity building at all levels of administration. Other pertinent policies issued by the Government of Ethiopia (GOE) include the Water Resources, Environmental Policy of Ethiopia, Ethiopian Water Resources

Management Policy, Health Policy, and the National Policy on Women. Applicable strategies and programs include the Conservation Strategy of Ethiopia (CSE), and the Second Urban Water Supply and Sanitation Program (2017 to 2022).

Physical Environment: Wolaita Sodo town is located in south-central Ethiopia, and is situated 383 and 167 kilometers (km) from Hawassa, a regional hub, and Addis Ababa, the nation's capital, respectively. Geographically, the town is situated between 6^{o}45'00'' and 7^{o}0'00''N and between 37^{o}35'00'' and 37^{o}53'00''E. The average annual temperature is 19.93^{o}C, with February seeing the highest temperature of 29.7^{o}C and August seeing the lowest temperature of 12.10^{o}C. The region experiences mono-modal precipitation, which often starts in March and lasts until October. The rainiest month is typically July, with an average peak rainfall of roughly 218 mm. Flood protection measures, such as drainage ditches along the road network and minor gorges cutting through the town, are essential due to the town's extremely undulating geography in the middle and north.

Biological Environment: An observation-based biodiversity assessment was made in the sites proposed for the FSTP and PCT. The town FSTP site was designed about 10km southwest of the state plantation forest at the specific area called "Pundunia Meda". The area is dominantly covered with eucalyptus tree species and also some other rare flora species.

Description of the Proposed Subproject: Wolayita Sodo town (WST) is among the towns that have been selected to take part in the UWSSP-II Program. The development objective of the project is to contribute to the improvement of the socio- economy of the residents by employing effective and efficient sanitation services. FSTP project has major components. The project includes the construction of a new FSTP and, the development of public and communal toilets.

Construction of new Fecal sludge treatment plant (FSTP): During this project phase, it is anticipated that 83.8 m^3 of fecal sludge will be produced daily during the dry season and 77.8 m^3 daily during the rainy season. To accommodate the building of further fecal sludge treatment units that will be built is selected areas. Wolaita Sodo FSTP development was suggested for two distinct alternatives. The best FSTP location was chosen by using the many specified criteria using fundamental environmental, social, and economic viability indices. Hence Alternative site 1 is selected best alternative site for FSTP**.** The selected alternative site is found in Larena Amba rural Kebele which was recently incorporated under the town boundary. The proposed FSTP is geographically located between 06^{o}47'01.37" N and 37^{o}44'33.06" E and has an elevation of 1769m. The area is situated southwest of the WST center, almost two kilometers west of the main Sodo to Arba Minch Asphalt road. The proposed area has different land use forms. The majority of the area is covered with Eucalyptus trees and the plantation has been done since 1974 E.C. Currently the Eucalyptus forest is owned and managed by the town's Environmental Protection Office. The office periodically sells Eucalyptus trees that are mature enough for logging. The area is suitable for investment and hence demarcated as an industrial

area of the town. The proposed FSTP construction site is found within the proximity of Ethio Kenya High voltage electricity transmission line infrastructure. The land is large enough to accommodate future expansion and it is a government-owned land that cannot displace any people. Consequently, the best technology option for FSTP in WST comprises a combination of process technologies that include Settling– thickening tanks, unplanted sludge drying beds, and constructed wetlands with an anaerobic baffled reactor (ARB). The technology sequentially consisted of fecal sludge and septage receiving and screening unit- Settling – thickening tanks- Sludge drying beds- Flow equalization tank and pumping station- Anaerobic baffled reactor– Wetlands feeding pumping station- Constructed wetlands.

Toilet construction: In the short-term intervention, 28 new public flush toilets were planned and placed to be built in locations where a public gathering occurs, such as market places, churches, mosques, public squares, particularly where festivals take place, parks, public areas, etc. In addition, it is intended to build 30 additional new communal toilets during the short-term intervention stage in locations with a shortage of sanitary facilities and/or where high densities of households share a single facility.

Public and Stakeholder Consultation: Participants of the PC were communities at the proposed FSTP, project sites. Grass-roots participation was done for the period of the visit to the subproject sites. The PC meeting, participants were the local community members comprised of the youth, women, sector experts, and institution leaders. Moreover, stakeholder meetings were also conducted at the WST water supply and sewage enterprise office with representatives from offices like the Environmental Protection Authority, Education department, Health Department, Culture and Tourism department, municipality, town urban development, and construction. To reach a consensus on the proposed site and technology alternatives tripartite consultation meetings were held among the client (MoWE), Design, and ESIA consultants. The outcomes of the consultations conducted with the aforementioned actors reveal that all the stakeholders have concerns about the implementation of the project. The main issues/concerns raised by the stakeholders and recommendations provided include the following:

- Offensive odor is a significant problem at the proposed treatment plant, this situation may continue even after implementation of the new FSTP.
- The importance of Federal and Regional governments' closer supervision and monitoring of construction activities for the sake of its completion.
- Measures that would minimize potential air and water pollution problems must be properly implemented.
- Local unemployed youth should be engaged in project implementation by giving priority to employment opportunities created by the project.
- It is important to consider positive supports like biogas production and business opportunities arising from the intervention of the project activities.

- The ESIA consultant discussed and accepted the proposed FSTP technology alternative by the design consultant ;
- Shifting the proposed project site location some 200m away from the Ethio-Kenya high electric transmission line is suggested by the ESIA team and accepted by the design consultant

Potential Impacts and Mitigation Measures: The sub-project is proposed mainly to improve the quality of the social and natural environment of WST. The lack of efficient sanitation facilities has triggered the deterioration of the social and natural environment with adverse consequences on human health, which is allied with water, air, and soil pollution resulting from inappropriate fecal waste disposal. Though the construction and operation of the planned subproject is a well-recognized solution to overcome the current environmental pollution and allied health impacts, some impacts are anticipated to occur during the construction, operation, and decommissioning phases of the project. In this ESIA both positive and adverse environmental and social impacts are identified. Adverse impacts were analyzed based on the type, magnitude, nature, spatial extent, and duration of impact, and assessed for significance.

Impacts during Construction Phases: The main positive impact during the construction phases is job creation for skilled and unskilled workers, mainly for the jobless youth in the project area, and for national and international contractors and consultants, skill and knowledge transfer (capacity building), Income to material/ equipment suppliers and contractors, boost to the local economy, urban service infrastructure improvement, improved health status of households and communities, fertilizer and biogas production.

Potential adverse impacts include:

- Loss of vegetation cover/ Vegetation clearance around the construction sites
- Air pollution due to dust emission caused by traffic movements on unpaved access roads, land clearing, excavation and earth moving activities, transport of spoil materials to disposal sites; and gaseous emissions from vehicles and construction equipment.
- Noise pollution is caused by the operation of construction vehicles and equipment.
- Soil compaction and soil erosion caused by project activities including site clearing, excavation in soil, and hauling of spoils to disposal sites, which would involve the operation of heavy-duty equipment and dump trucks.
- Pollution of water bodies due to insufficient handling and spillage of pollutants (like fuel, oils, greases, and paints), and release of solid and liquid wastes from construction camps and workshops.
- Increased traffic congestion or obstruction of normal traffic flows and traffic accidents on the existing roads connecting both Treatment Plants (TPs)
- Impacts on occupational health and safety resulting from construction activities, operation of project vehicles and equipment, storage and use of hazardous chemicals and explosives, dust and exhaust emissions, etc.

- The spread of communicable diseases like HIV/AIDS and other sexually transmitted infections due to the entrance of construction workers and relationships with local women including commercial sex workers.

The identified impacts are predicted to be moderate to high, short-term, reversible, and direct adverse impacts. They can be minimized to acceptable levels by adopting appropriate mitigation measures including the following:

- Re-vegetation of ¼ of the area delineated and the perimeters of the FSTP with commensurate amount of trees, buses, and grasses lost during site clearance; as much as possible re-plant the indigenous vegetation as much as practical once work is completed
- Use modernized technology or recent equipment in excavation works that will minimize dust generation from earthen materials and noise emissions and vibration.
- Develop a waste management plan before the start of construction activities;
- The contractor shall develop a TMP (Traffic Management Plan) and incorporate proposed arrangements for traffic diversions with details of all necessary budgets and signals.
- Consistent inspections and maintenance of vehicles and equipment to reduce excessive exhaust emissions, and prevent fuel spills by filling fuel at only designated fuel stations.

Impacts during the Operation Phase: Most of the beneficial impacts of the project will be harnessed during the operation phase of the subproject's development. These embrace enhancement of water quality of receiving water bodies, protection of soil resources from hazardous chemicals, improvements of public health, and improvements of agricultural productivity, biogas energy production, and production of compost/fertilizers from dewatered sludge removed from the FSTPs process. Potential adverse impacts during the operation phase include:

- Pollution of ground water at FSTP site due to accidental overflow of wastewater into permeable soils.
- Improper treatment and disposal of fecal sludge and toilets can lead to the contamination of water sources, including groundwater and surface water.
- The construction of FSTP along the selected open area will permanently change the surrounding landscape scenery into a walled-in enclosure.
- Some offensive odor at and around the FSTP sites is mainly due to the release of hydrogen sulfide resulting from anaerobic digestion.
- FSTP can pose several occupational health risks to workers involved in the collection, transportation, and treatment of fecal sludge.

The identified adverse impacts of the operation phase are possible, reversible, of moderate to high significance, and long-term. They can be mitigated through:

- Constructing FST foundation and direct influence areas with concrete lining to avoid leakage of wastewater through permeable soils and weathered and fractured rocks into the groundwater system;

- Applying aeration, proper chemical dosing, and oxidation or pH adjustment to reduce offensive odor;
- Adherence to national rules and regulations and appropriate contract specifications and guidelines;
- Maintaining appropriate buffer zones around the treatment plants and planting environmentally favorable indigenous trees to prevent the spread of nuisance odor and improve the aesthetic view of the treatment sites;
- Proper handling of chemicals and other materials to be used in the treatment process and keeping good personal hygiene;
- Covering tanks or installation of exhaust hoods;
- Operating equipment at optimum/design conditions;

Impacts during decommissioning Phases

The adverse impact during the **decommissioning** phases includes:

- Decommissioning a fecal sludge treatment plant and toilets can result in the release of contaminants or pollutants into the surrounding environment, particularly if the plant has not been properly maintained or cleaned.
- Workers involved in decommissioning may be exposed to hazardous materials through inhalation, ingestion, or contact with the skin or eyes that can pose a risk to their health.
- Decommissioning a fecal sludge treatment plant will be stopped working and may have economic impacts on the surrounding community, particularly if the plant has been a source of employment or revenue.

The identified adverse impacts of the decommissioning phase are possible they can be mitigated through the:

- Conducting a site assessment to identify potential environmental and health risks associated with the plant.
- Consider review of plant records, site inspections, and environmental sampling to identify potential contaminants or pollutants that may need to be addressed.
- Recruiting a qualified health and occupational safety officer who will oversee OHS matters on-site
- Based on their skill, knowledge, experience, and interest, vulnerable community groups must be transferred to another secured job opportunity;

Environmental and Social Management Plan: This subdivision delivers an Environmental and Social Management Plan (ESMP) that encompasses a precise plan of action for the proposed mitigation measures to ensure implementation of the “mitigation measures” to avoid or reduce adverse impacts and enhance positive impacts from the construction and operation of the proposed project components.

ESMP is the key to certifying that the environmental and social quality of the project influence area does not deteriorate due to the implementation of the proposed development project

covering all aspects of project implementation in its different phases. It is generally used as the basis for establishing the environmental and socio-economic behavior that the proposed project entails during its various stages together with the decommissioning phase.

The ESMP for the proposed project consists of a set of feasible and cost-effective mitigation and official measures to be assumed during the different phases of the project to remove or reduce to tolerable levels the adverse environmental and social impacts recognized. It is prepared in such a way that it functions, as a document that sets forth those practices that will be implemented to prevent, control, and mitigate significant negative environmental and social impacts rising as a consequence of the implementation of the proposed project. Therefore, the ESMP is focused on mitigating, minimizing, or controlling negative impacts rising all over the different phases of the project. This ESMP outlines the roles and responsibilities of various stakeholders for guaranteeing well-integrated implementation and monitoring of the project operations.

Environmental and Social Monitoring Plan: Environmental monitoring is an important component of environmental management as it provides the basis for rational management decisions regarding impact control. Monitoring will provide the information necessary for feedback into the environmental management process including feedback about the actual environmental and social impacts of a project and will assist in identifying where additional mitigation effort or where an alteration to the adopted management approach may be required.

The environmental monitoring plan is developed to provide a basis for evaluating the efficiency of the proposed mitigation measures and for updating the actions and impacts of baseline data. It also gives information for the adoption of additional mitigation measures if the proposed measures are found insufficient. Accordingly, it provides information for management decisions in the different phases of the project. Monitoring should be performed during all stages of the project (construction, operation, and decommissioning) to ensure that the impacts are no greater than predicted, and to verify the impact predictions. The monitoring program will indicate where changes to procedures or operations are required, to reduce impacts on the environment or local population.

Implementation Arrangements and capacity building: The responsibility for implementing the ESMP of the supplement ESIA during construction will be of the contractor, WSWSSA, and the office of environmental protection. During the operation and maintenance of the development works, the responsibility will be WSWSSA. The WSWSSA recruited environmental and social safeguard experts who are responsible for monitoring the implementation of management tools and capacity buildings. The environmental sustainability of the sub-projects is dependent on the capacity of institutions at all levels to carry out the associated ESMP implementation work. Furthermore, the bid-winning contractor and engineering supervisors also have to deploy the Environmental and social experts to manage the outlined environmental risks with

their mitigation measures management. In the short-term, this employment organization is thought appropriate. Thus, WSWSSA must allocate sufficient resources for training and capacity building. These efforts will not only benefit the authorities but will also build local capacity to carry out extra development advantages.

Conclusion: Currently WST has a significant shortage of safe and suitable sanitation facilities. Sanitation in the town is also deficient as reflected by inadequate facilities for the disposal of human excreta, and refuse material. There is therefore a pressing need to address the sanitation problems in WST to improve the quality of life of the people, generate economic development, and create employment. It is assured that implementation of the proposed subprojects of WST will be a major solution to minimize the prevailing poor sanitation-associated with environmental pollution and its consequences in the town and downstream areas. The subprojects will assist as a very important intervention for the protection of the socio-economic and biophysical environment of the WST.

The identified adverse environmental, social, and health impacts related to the construction and operation of the proposed subprojects as compared to the benefits of the project are of low to moderate significance and can be easily mitigated to an acceptable level by properly applying the mitigation measures stated in this report.

A suitable implementation of the proposed mitigation and enhancement measures for each stage of the project will avoid or minimize adverse impacts and enhance beneficial impacts. Therefore, it is suggested that the enhancement and mitigation measures for the identified potential positive and negative impacts correspondingly are appropriately implemented. The benefits of implementing these measures by far are more important than the costs to be incurred. Moreover, saving life supports environmental resources and ecosystems from further pollution and deterioration would be of utmost significance. The estimated Environmental and social safe guard management and monitoring plan budget for the WST FSTP project is **17,154,500.00 (Seventeen Million One hundred fifty four thousand five hundred Birr).**

1. Introduction

1.1 Background

Urban sanitation is indispensable for human health, social well-being, and economic development. It helps to prevent the spread of contagious diseases and environmental pollution through the use of improved sanitary facilities like flush toilets and fecal sludge treatment technologies. Fecal Sludge Management (FSM) is a global concern, particularly in low-income countries which predominantly rely on on-site sanitation technologies. That is why, in poor and growing urban areas of low-income countries like Ethiopia, fecal sludge management represents a growing challenge; generating significant negative public health, social wellbeing, and environmental risks.

Ethiopia is one of the Sub-Saharan African countries with poor sanitation services, and rapid urbanization is exacerbating the situation (Oliver, 2015). As a result, people in many cities and cities lack access to adequate sanitation systems, consequently causing environmental and social problems (ESMF, 2017).

In addition, cities and cities have increased in size and number over the past 20 years. Such trends will result in the need for more basic urban services and infrastructure in the years to come, including adequate sanitation. Meanwhile, the government of Ethiopia has set out to transform the country from a rural to urban economy-led industrialization. Meeting this goal is dependable on the cities and cities' ability to meet urban standards of living. And one of these urban living standards is access to improved urban sanitation. Thus, the government and the World Bank have launched the second Urban Water Supply and Sanitation Program (UWSSP II).

UWSSP-II aims at increasing access to enhanced water supply and sanitation services in cities and cities of Ethiopia. The UWSSP-II is intended to aid in the government's efforts to eliminate open defecation, raise the proportion of the population using a "safely managed" sanitation service, and improve water supply services through increased operational effectiveness and expansion of water supply service to underserved areas.

Therefore, the Federal Democratic Republic of Ethiopia's (FDRE) Water and Energy Minister (WOWE) hired Green Sober Environmental Consultant Pvt. Ltd. Co. to conduct an ESIA for the fecal sludge treatment plant (FSTP) and toilet (public and communal) construction project under UWSSP-II in seven city s in Ethiopia. The UWSSP-II is a five-year program co-financed by the government of Ethiopia and the World Bank. As part of the contract, this ESIA is developed for WST FTSP and toilets construction project.

1.2 The objective of the ESIA

1.2.1. General Objective

The main objective of the consultancy is to carry out the environmental and social impact assessment on an FSTP construction in seven UWSSP-II implementing WSTs). The consultant is

expected to identify environmental and social impacts during the life cycle of the fecal sludge treatment plant and recommend appropriate mitigation measures. Further, the consultant will prepare environmental and social management and monitoring plans. Additionally, under the ESIA process, the consultant will develop an indicative socio-economic survey for the preparation of resettlement action plans (ARAPs) for potentially affected villages.

1.2.2 Specific Objectives

The specific objectives are:

- Examination of the National and the World Bank environmental safeguard policies and regulations that will be triggered by the subproject activities at any development phase of the sub project and these shall include but not be limited to the project ESMF, Gender Action Plan (GAP), World Bank's Gender strategy and GBV requirements.
- Describe the views and concerns of the public and stakeholders towards the implementation of the subproject.
- Establish baseline features of the biophysical, socio-economic, and cultural attributes in the subproject influence area.
- Identification and evaluation of significant impacts (both beneficial and adverse) due to the subproject implementation that requires appropriate mitigation measures.
- Propose specific mitigation for inclusion in the subproject detail design and management plan to reduce or avoid significant adverse environmental and social impact including gender and potential GBV risks.
- an Analyze alternatives to the proposed sub-projects in terms of technology, design, and operation, including the "without project" situation.
- Assessment and identification of capacity gap and propose training and capacity building requirements for implementation of environmental mitigation and monitoring.
- Preparation of Environmental and Social Management Plan.
- Cost estimate for each proposed mitigation measure and monitoring program.
- Develop a monitoring program that will be followed during the project implementation.
- Recommend environmental and social compliance requirements, design measures, and staffing that should be included in the works contract documents.

1.3 Scope of the ESIA Study

One of the scopes of the ESIA was pertinent policy, legal instruments, standards and guidelines, and institutional arrangement review. The other was a collection of city-wide biophysical, socioeconomic, and cultural baseline data. Thus, an all-encompassing baseline data on soil mapping, land use and cover, water and hydrology, landscape and visual, archaeological and cultural heritage, air quality and noise, biodiversity and ecology, and socio-economic environment was collected. The stakeholder consultation and indicative household survey for the likely project-affected households were also made. The fourth scope was impact

identification and development of possible mitigation measures. Finally proposal of human resources, capacity building, and monitoring plan with time and cost implications.

1.4 Experts participated in ESIA

As the environmental and social impact assessment of the FSTP project requires a multidisciplinary approach, experts keen to perform the ESIA assignment were engaged from different relevant disciplines in the areas of environment, waste management, hydrology, climate change, GIS, socio-economy, and biodiversity (Annexed).

1.5 Organization of the ESIA report

Chapter One	Background, scope, objectives, limitations, and organization of the study
Chapter Two	Policy and legal frameworks analyses and Institutional Arrangement
Chapter Three	ESIA Study Approach and Methods
Chapter Four	Description of the proposed development sub-program
Chapter Five	Stakeholder Consultation and Analysis
Chapter Six	Biophysical and Socio-Economic Baseline Information of the study area
Chapter Seven	Preliminary census of the project-affected households or persons
Chapter Eight	Project Alternative Analysis
Chapter Nine	Environmental and social Impacts and their proposed Mitigation Measures
Chapter Ten	Environmental and social management and monitoring plan
Chapter Eleven	Conclusions

2. Policy Legal Frameworks and Institutional Arrangement

The implementation of the FSTP subprojects has the potential to cause environmental and/or social impacts that shall be addressed following relevant Ethiopian legislation as well as the requirements of the World Bank Environmental and Social safeguards and standards. The subsections below provide more details on the applicable legislative framework for the ESIA.

2.1 Policy and legal Frameworks

2.1.1 Constitution of the Federal Democratic Republic of Ethiopia

The Constitution is the supreme law of the country, whose provisions must be complied with by all other policies, regulations, and institutional frameworks. The Constitution of the FDRE (Proclamation No. 1/1995 as amended) is the foundation for human rights, natural resources, and environmental management. The concepts of sustainable development and environmental rights are enshrined in the constitution of the FDRE through articles 43 and 44, which state among others the right to development and the right to live in a clean and healthy environment.

Article 44(2) of the Constitution states that all persons who have been displaced, or whose livelihood has been adversely affected as a result of state programs have the right to commensurate monetary or alternative means of compensation including relocation with adequate State assistance. The government shall pay fair compensation for property found on the land but the amount of compensation shall not take into account the value of land. Moreover, the Constitution states that, without prejudice to the right to private property, the government may expropriate private property for public purposes subject to payment in advance of compensation commensurate to the value of the property (Article 40(8). Moreover, Article 43 (2) dealing with the rights to development states that nationals have the right to participate in national development and, in particular, to be consulted concerning policies and projects affecting their community.

2.1.2 Environmental Policy and Strategies

To further amplify the Constitutional provisions on environmental protection, the Environmental Policy of Ethiopia was approved in 1997 (EPA, 1997). The policy goal is to improve the health and quality of life of the people of Ethiopia and to promote sustainable social and economic development through sound management and use of natural, human-made, and cultural resources and the environment.

The policy seeks to:

Ensure that essential ecological processes and life support systems are sustained, biological diversity is preserved and renewable natural resources are used in such a way that their regenerative and productive capabilities are maintained and where possible enhanced so that the satisfaction of the needs of future generations is not compromised; where this capability is already impaired.

2.1.3 Land Tenure Policy

The Constitution of the Federal Democratic Republic of Ethiopia (FDRE) states that the right to ownership of rural and urban land, as well as all the natural resources, is exclusively vested in the State and People of Ethiopia. Article 40 of the Constitution indicates that land is a common property of the Nations, Nationalities, and the People of Ethiopia, and shall not be subjected to sale or other means of transfer. The constitution of FDRE retained land under the control of the people and government of Ethiopia thus, prohibiting its buying and selling. Article 4(5) of the proclamation 94/1994 also deals with the provision of land for the conservation, development, and utilization of state forests or protected areas. However, this can be effective only after the consultation and consent of the peasantry and subject to the assurance of their benefits.

2.1.4 National and Regional Conservation Strategy

Since the early 1990s, the Federal Government of Ethiopia has undertaken several initiatives that aim to develop regional, national, and sectoral strategies to conserve and protect the environment. Paramount among these was the conservation strategy of Ethiopia (CSE, 1996). This document provides a strategic framework for integrating the environment into new and existing policies, programs, and projects. It is also an important policy document, which views environmental management as an important component of development. It recognizes the importance of incorporating environmental factors into development activities from the outset.

The major environmental and natural resources management issues facing Ethiopia are well documented in the CSE (FDRE, 1997). The CSE sets out detailed strategies and action plans as well as the institutional arrangements required for the implementation of sect oral as well as cross-sectoral interventions for the management of Ethiopia's natural, man-made, and cultural resources.

2.1.5 National Biodiversity Policy

The National Biodiversity Policy (NBP) was established in 1998 based on a holistic ecosystem approach to conserve, develop, and utilize the country's biodiversity resources. The policy provides guidance towards effective conservation, rational development, and sustainable utilization of the country's biodiversity, and contains comprehensive policy provisions for the conservation and sustainable utilization of biodiversity. Integration of biodiversity conservation and development in federal and regional sect oral development initiatives, and mobilization of international cooperation and assistance, have been identified as the principal strategies for implementation of the policy.

This policy framework provides direction and regulatory tools for overall conservation and sustainable development of the country. In line with this, the proposed project will have and be expected to support the conservation of nature including the forest resource as has been required.

2.1.6 Ethiopia's Climate Resilient Green Economy Strategy

To cope with the prevailing environmental problems such as land degradation and climatic hazards (rainfall fluctuation, increasing temperature, flooding), and speed up its socioeconomic development, the Government of Ethiopia has planned a climate-resilient green economy as a development strategy. This development direction promotes environmental protection, reducing fossil fuel consumption which releases greenhouse gases into the atmosphere. With the demand for energy growing with the increasing population, industrialization, and urbanization, the government realized that harnessing clean and renewable energy sources such as wind, solar, hydro, and geothermal energy sources was critical. It has indicated that these natural resources would deliver electricity at virtually zero GHG emissions. The generated electricity is a fundamental enabler of modern economic development, from powering cities and fueling industrial activity to pumping water for irrigation purposes in agriculture. The government also decided to increase its income through exporting electric power generated from clean sources to neighboring countries.

2.1.7 Ethiopian Water Resources Management Policy

The overall goal of water resources policy is to enhance and promote all national efforts towards the efficient, equitable, and optimum utilization of the available water resources of Ethiopia for significant socioeconomic development on a sustainable basis. The policy has three sub-polices: water supply and sanitation policy, irrigation policy, and hydropower policy. For this particular ESIA study Water Supply and Sanitation Policy objectives are summarized here as follows:

The Water Supply and Sanitation policy objectives are the provision of, as much as conditions permit, sustainable and sufficient water supply services to all the peoples of Ethiopia; satisfying water supply requirements for livestock, industries, and other users as much as conditions permit; carrying out operation and maintenance of all water supply and sanitation services sustainably and efficiently; promoting sustainable conservation and utilization of the water resources through protection of water sources, efficiency in the use of water as well as control of wastage and pollution; creating sustainable capacity building in terms of the enabling environment, including institutions, human resources development, legislation and regulatory framework for water supply and sanitation; and enhancing the wellbeing and productivity of the people by creating conducive environment for the promotion of appropriate sanitation services (FDRE, 2010).

2.1.8 National Policy of Women

The national Policy of Women (NPW) was issued in March 1993. In this policy it is indicated that government policies, laws, regulations, plans, programs, and projects should be based on the following objectives: to ensure the participation of women in the formulation of government policies, laws, regulations, programs, and projects that directly or indirectly benefit and concerns of women; to insure participation and involvement of women in implementation and

decision-making processes; and to ensure equal access of men and women to the country's resources.

2.1.9 National Health Policy

Ethiopia had a low level of health coverage even in comparison with other Sub-Saharan countries. This is largely related to low levels of income and widespread poverty, low levels of education, nutritional deficiencies, poor environmental conditions, and inadequate access to health services.

Health Sector Development Plans and Strategies have been designed to implement the stated health principles within a defined period. The strategies include raising the awareness of personal and environmental health care and sanitation through Information, Education, and Communication; control of disease; and promotion of primary health care through community participation.

2.1.10 National Policy on HIV/AIDS

The 1998 Policy on HIV/AIDS of the Federal Democratic Republic of Ethiopia urges communities at large, including government ministries, local governments, and civil society to feel responsibility for carrying out HIV/AIDS awareness and prevention campaigns "to provide an enabling environment for the prevention and control of HIV/AIDS in the country". So it is expected that sufficient awareness exists within the community. In addition, all the workers and contractors working in the proposed sub-projects shall be treated fairly following the policy.

2.1.11 Urban Wastewater Management Strategy

MoWIE issued this strategy in 2017. The purpose of this strategy is to provide a common understanding of the strategic vision to guide wastewater management partners towards an effective and coordinated response through prioritized interventions and targeted programs, whilst encouraging efficient and sustainable use of resources. The objectives of the strategy are geared toward the development of strong wastewater management institutions, master plan preparation, implementation methods, protecting the environment from wastewater discharge, social and cultural sustainability, wastewater collection and treatment, wastewater collection transportation, and treatment and reuse of treated effluent and sludge.

2.1.12 Integrated Urban Sanitation and Hygiene Strategy

The Ministry of Health (MoH) issued the strategy in 2016. The goal of the strategy is to mitigate the negative impacts of poor urban sanitation and hygiene on health, environment, society, education, and the economy by promoting full sanitation and hygiene systems. The basic premises for the MoH to formulate this strategy were issues around urban sanitation and hygiene, which are complicated due to cross-sectoral interventions and differences between cities. The implementation of the strategy is expect to have a positive impact on the economy of the country, the natural environment, health and wellbeing of all urban dwellers, including the most vulnerable ones. The strategy encourages all sanitation-related interventions to be

based on city and town development plans, taking advantage of economies of scale, sharing of best practices within the country, and involvement of the private sector and Community Based Enterprises (CBEs).

2.1.13 Environmental Impact Assessment (Proclamation No, 299/2002)

Proclamation (No 299/2002) aims primarily at making the ESIA mandatory for schedule I and schedule II category projects and programs. The proclamation specifies the projects and activities that will require an ESIA. The proponent of the project must prepare the ESIA following the format specified in the legislation. The proclamation requires, among other things:

- ✓ Licensing agencies to ensure that the requisite authorization has been duly received before issuing an investment permit, a trade or operating license, or a work permit to a business organization;
- ✓ Specified categories of projects to be subjected to an ESIA and receive authorization from the competent or the relevant regional environmental agency before commencing implementation of the project;
- ✓ The authority or the relevant regional environmental agencies may issue an exemption from carrying out an ESIA in projects supposed to have an insignificant environmental impact;
- ✓ A licensing agency may suspend or cancel a license that has already been issued where the institution responsible for the environment at the federal level or the relevant regional environmental agency suspends or cancels environmental authorization;
- ✓ Procedures that need to be followed in the process of conducting an environmental impact assessment are described in the Proclamation. Thus, a project developer is expected to act as follows: Undertake a timely environmental impact assessment; Identify the likely adverse impacts, incorporating the means of their prevention, and submit the environmental impact study report accompanied by the necessary documents to the institution responsible for environment at the federal level or the relevant regional environmental agency for review and approval.

Based on the proclamation the EPA Guideline (2003) developed, proposed projects are assessed and classified as one of the following schedules:

- ✓ **Schedule 1:** Projects which may have adverse and significant environmental impacts, and may, therefore, require full ESIA;
- ✓ **Schedule 2**: Projects whose; type, scale, or other relevant characteristics have the potential to cause some significant environmental impacts but are not likely to warrant a full EIA study.
- ✓ **Schedule 3**: Projects that have negligible direct environmental impacts and hence do not require environmental impact assessment.

Therefore, Wolaita Sodo FSTP construction activities fall under schedule II which can cause some environmental and social impacts but are not likely to warrant a full ESIA.

2.1.14 Environmental Pollution Control Proclamation

Ethiopian environmental pollution control proclamations No-300/2002 prove that some social and economic development activities may cause environmental harm that could jeopardize production. Article 3/1 of the proclamation explains environmental standards and simultaneously prohibits no person shall polluting or causing any other person to pollute the environment by violating the relevant environmental standard. Article 4 this same proclamation elucidates about management of wastes, chemicals and radioactive substances by the producer.

2.1.15 Solid Waste Management Proclamation

The main objective of the solid waste management proclamation (No 513/2007) is to enhance all stakeholders' capacity to manage the possible adverse impacts while creating environmentally, economically, and socially beneficial resources out of solid waste.

In article 17(1), it is depicted that without obtaining authorization, a person who implements a solid waste management project that requires a special permit before its implementation as determined in a directive issued by the relevant environmental agency commits an offence and shall be liable according to the relevant provision of the Criminal Code. And article 17(3) states that any manufacturer, importer, or seller who violates the provision of this Proclamation commits an offense and shall be liable according to the relevant provision of the Criminal Code.

2.1.16 Hazardous Waste Management and Disposal Control Proclamation

The objectives of the Hazardous Waste Management, Disposal Control Proclamation (Proc. No.1090/2018) are to create a system for the environmentally sound management and disposal of hazardous waste and to prevent damage to human or animal health, the environment, biodiversity, and property due to the mismanagement of hazardous waste. The law addresses the management of hazardous waste including the application of cleaner production principles to minimize hazardous waste, the responsibilities of hazardous waste Generators, transportation of hazardous waste, precautionary measures to be taken during transportation and storage of hazardous wastes, and reuse, recycle, and disposal of hazardous wastes. In this proclamation wastewater in general terms has been categorized as hazardous waste in Annex One of this Proclamation and any waste which has substances or wastes containing viable microorganisms or their toxins which are known or suspected to cause disease in animals or humans is also considered to be hazardous.

Under the proclamation the hazardous waste generator shall have the responsibilities to collect, segregate, and dispose or cause to be collected, recycled, or disposed of hazardous waste by an authorized body; ensure that the containers of hazardous waste are properly packed and conspicuously labeled with Amharic and English languages or other languages of

the country as may be necessary; keep record on the type and quantity of hazardous waste that exist at the temporary hazardous waste storage facility; and show the record at any time when requested by inspector, and not to store hazardous waste at a temporary storage facility for a period exceeding one month. The relevance of this proclamation for the subproject is that it is a legal base regarding the way wastewater and sludge handling and management, and discharge to the environment as well as workers' welfare.

2.1.17 Expropriation of Land, Payments of Compensation and Resettlement Proclamation

The Expropriation of Land holdings for Public Purposes, Payments of Compensation and Resettlement Proclamation (No. 1161/2019) has revoked proclamation No. 455/2005 and is applicable throughout the country in rural and urban centers on matters relating to land expropriation, payment of compensation and resettlement of landholders whose land is expropriated for public purpose. The Proclamation defines public purpose as a decision that is made by the cabinet of a regional state or city administration or the appropriate federal authority based on an approved land use plan/development plan / structural plan under the belief that the land use will directly or indirectly bring better economic and social development to the public.

2.1.18 Labour Legislation (Proclamation No.1156/2019)

The labor proclamation obliges that an employer shall take the necessary measures to adequately safeguard the health and safety of the workers. To ensure workers' safety and job security the need to respect this proclamation has been clearly stated in this document. Under this proclamation, the following specific issues have been found relevant and important to be recognized and implemented accordingly during the operation of the plants under process. Freedom of association and collective bargaining: the right of all workers to form and join trade unions and bargain collectively. Representatives should not be subjected to discrimination and shall have access to all workplaces necessary to enable them to carry out their representation section.

Living wages: wages and benefits paid for a standard working week should meet at least legal or industry minimum standards and always be sufficient to meet the 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 on wages should be available to the workers in an understandable and detailed form.

Equal handling: workers should have access to jobs and training on equal terms, irrespective of gender, age, ethnic origin, color, marital status, sexual orientation, political opinion, religion, and social origin. Physical harassment or psychological oppression, particularly of women workers must not be tolerated.

2.1.19 Cultural Heritage Conservation

The objectives of the Research and Conservation of Cultural Heritage Proclamation No. 209 /2000 are among others to carry out registration and supervision of cultural heritage, to protect cultural heritage against man-made and natural disasters. There is an Authority for the Research and Conservation of Cultural Heritage accountable to the Minister of Culture.

2.2 World Bank Group Environmental, Health, and Safety Guidelines

The general approach to the management of Environmental, Health, and Safety (EHS) issues at the facility or project level is for the effective inclusion of EHS considerations into corporate and facility-level business processes in an organized, hierarchical approach that includes the following steps:

- ✓ Identifying EHS project hazards(threats to human health and what they value) and associated risks as early as possible in the facility development or project cycle, including the incorporation of EHS considerations into the site selection process, product design process, engineering planning process for capital requests, engineering work orders, facility modification authorizations, or layout and process change plans;
- ✓ Involving EHS professionals, who have the experience, competence, and training necessary to assess and manage EHS impacts and risks, and carry out specialized environmental management functions including the preparation of project or activity-specific plans and procedures that incorporate the technical recommendations
- ✓ Understanding the likelihood and magnitude of EHS risks, based on:
  - ❖ The nature of the project activities, such as whether the project will generate significant quantities of emissions or effluents, or involve hazardous materials or processes;
  - ❖ The potential consequences to workers, communities, or the environment if hazards are not adequately managed, may depend on the proximity of project activities to people or to the environmental resources on which they depend.
  - ❖ Prioritizing risk management strategies to achieve an overall reduction of risk to human health and the environment, focusing on the prevention of irreversible and/or significant impacts.
  - ❖ Favoring strategies that eliminate the cause of the hazard at its source, for example, by selecting less hazardous materials or processes that avoid the need for EHS controls. When impact avoidance is not feasible, incorporating engineering and management controls to reduce or minimize the possibility and magnitude of undesired consequences, for example, with the application of pollution controls to reduce the levels of emitted contaminants to workers or environments.
  - ❖ Preparing workers and nearby communities to respond to accidents, including providing technical and financial resources to effectively and safely control such events, and restoring workplace and community environments to a safe and healthy condition.

The WBGEHS guideline of wastewater and ambient water quality set a standard for basic parameters for sanitary discharge limit (Table1).

Table 1 Indicative value for treated sanitary sewage discharges

Pollutant	Unit	Maximum value
pH	pH	6-9
BOD	mg/l	30
COD	mg/l	125
Total nitrogen	mg/l	10
Total phosphorus	mg/l	2
Oil and grease	mg/l	10
Total suspended solids	mg/l	50

Source: WBG EHS (2007) standard of Wastewater and ambient air quality

Thus, it is important to comply with the required discharge limit for all effluent parameters during the entire operation period which implies that it is possible to use the treated fecal sludge for different purposes.

2.3 World Bank Safeguard Policies

World Bank (WB) has several Operational Polices (OP) to ensure that the environment and human populations are protected during the development process. The proposed project will trigger some of the WB safeguard policies due to the nature and location of the project in the receiving environment. The ESIA will identify which impacts are likely to be contrary to these OPs. Where mitigation, management, or monitoring is required, it will be identified in the Environmental and Social Management Plan (ESMP). Relevant WB OPs that may be considered are:

Environmental and Social Assessment (OP 4.01): This policy 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. According to the WB OP 4.01, Environmental Assessment (EA), and the National EIA guideline (2003) the proposed project falls under category B. The proposed UWSSP II triggers the WB OP 4.01, Environmental Assessment Policy. Thus, according to the WB categorization of ESIA study reports WST FSTP was grouped under category 'B' which was again endorsed by the WB as a financier.

Natural Habitats (OP 4.04): This policy is triggered for environmentally sustainable development through protecting, conserving, maintaining, and rehabilitating natural habitats and functions. Moreover, when there is a potential for significant degradation of natural habitats, directly through construction or indirectly through human activities induced by the

project. OP 4.04 will not be triggered due to the absence of any natural habitat in WST FSTP or other components of the project.

Projects on International Waterways (OP 7.50)*:* This policy is relevant if a project activity adversely impacts the quality and quantity of international waterways shared with one or more countries. This project triggers OP 7.50 given that it is located within the Ethiopian Rift Valley water Basin, which is shared with the Kenyan ground water sources.

Indigenous Peoples (OP 4.10): The objective of this policy is to (i) ensure that the development process fosters full respect for the dignity, human rights, and cultural uniqueness of vulnerable and historically under-served communities and peoples; (ii) ensure that they do not suffer adverse effects during the development process; and (iii) ensure that such communities and peoples receive culturally compatible economic benefits. In WST FSTP, No indigenous people will be affected, so it does not trigger OP 4.10.

Physical Cultural Resources (OP 4.11): The objective of this policy is to assist countries in avoiding or mitigating adverse impacts of development projects on physical cultural resources (PCR). For purposes of this policy, "physical cultural resources" are defined as movable or immovable objects, sites, structures, groups of structures, natural features, and landscapes that have archaeological, paleontological, historical, architectural, religious, aesthetic, or other cultural significance.

Involuntary Resettlement (OP 4.12): This policy covers not only physical relocation but also any loss of land or other assets resulting in (i) relocation or loss of shelter; (ii) loss of assets or access to assets; (iii) loss of income sources or means of livelihood, whether or not the affected people must move to another location.

From the field observation it is confirmed that the main wastewater sewer lines will be installed along the existing roads and the wastewater treatment plants will be constructed on public land or agricultural land.

2.4 Comparison of the World Bank Safeguard and National Polices

The summary of the Ethiopian and the World Bank safeguard policy comparison is indicated in table (2)

Table 2 Ethiopian and the World Bank policy comparison

Theme	The Ethiopian legislations	WB safeguard OP	Comparison	Measures
Social issues in ESIA	EIA proclamation 299/2002 overlooked social issues. That is the proclamation title itself was written as "Environmental Impact Assessment (EIA)" not as Environmental and Social Impact Assessment (ESIA) and the public disclosure of the ESIA is not mandatory. Preliminary social screening was not stated.	The Bank's operational policy OP 4.01 gives impasses to both environmental and social impact assessment of programs or subprojects. It also made the public disclosure of category A & B ESIA mandatory.	The EIA proclamation 299/2002 overlooked social assessment of subprojects and programs and public disclosure of the ESIA whereas OP 4.01 gives special focus to them	When the government legislation is found less stringent in addressing issues compared to the WB procedures, the safeguard policies of the WB will be applied
Eligibility for compensation	Proclamation No1161/2019, Article 8(1) allows landholders to be eligible for compensation when the landholders or their agents whose landholdings are to be expropriated shall submit landholding certificates or other proofs that show their landholding rights over the lands that are decided to be expropriated to the urban or rural land administration office on the schedule of the office. This gives entitlement only to those who have formal legal rights over their land holdings	World Bank OP4.12 gives eligibility to: those who have formal legal rights to the land; those who do not have formal legal rights to land, but have a claim to such land; and those who do not have recognizable legal rights or claims to the land.	According to World Bank OP4.12 eligibility for compensation is granted to all affected parties but the Ethiopian Legislation only grants compensation to those with lawful possession of the land that is expropriated. It does not recognize those without a legal right or claim as eligible for compensation.	Eligibility criteria for compensation and assistance shall be in line with the WB eligibility for benefits

Concern for the indigenous people's right	The Expropriation of Land holdings for Public Purposes, Payments of Compensation and Resettlement Proclamation No. 1161/2019 does not clearly articulate the rights of indigenous people. Moreover, it is not importance for separate social assessment to address how indigenous people are closely tied to land, forests, water, wildlife, and other natural resources,	The World bank BP 4.10- gives a focus on Indigenous Peoples's separate social assessment and the need for indigenous people plan (IPP) preparation to manage their wisdom a sustainably.	The World bank BP 4.10- necessitates the need for separate social assessment and also gives special consideration to land and related natural resources to address how Indigenous Peoples are closely tied to them but the Proclamation No. 1161/2019 overlooked it.	When the livelihood of the indigenous might be affected social assessment and preparation of IPP should be in line with the world bank BP 4.10.
Actions for livelihood restoration and assistance to vulnerable groups	There are no specific laws or regulations specifying support for livelihood restoration and transition& and moving allowances. Ethiopian law makes no specific accommodations for potentially vulnerable groups such as women, children, the elderly, ethnic minorities, indigenous people, the landless, and those living under the poverty line.	Livelihoods and living standards are to be restored in real terms to pre-displacement levels or better. OP 4.12 further requires attention to be given to the needs of vulnerable groups like people with disabilities below the poverty line, landless, elderly, women and children, indigenous groups, ethnic minorities, and other disadvantaged persons	Ethiopian policy and legislation would need to be aligned with the WB policy to effectively guarantee the rights of all affected persons by involuntary resettlement. Vulnerable groups are at the highest risk or prone to experience negative effects due to resettlement and should receive special consideration during the preparation of a resettlement policy framework.	The treatment of the vulnerable groups should be following *OP 4.10*

2.5 UWSSP II Specific Legal Frameworks

2.5.1 Environmental and Social Management Framework (ESMF)

The overall objectives and purposes of the ESMF of UWSSP II can be summarized as follows:

- Review Ethiopia's environmental policies, legislation, regulatory and administrative frameworks in conjunction with the World Bank's ten safeguard policies. Where there are gaps between these policies make recommendations as to how to bridge these gaps in the context of the proposed project as appropriate;
- Develop a stakeholder consultation process that ensures that all key stakeholders, including potentially affected persons, are aware of the objectives and potential environmental and social impacts of the proposed project;
- Assess the current ability at the regional and/or city level to implement the recommendations of the ESMF, and make appropriate recommendations;
- Assess the potential environmental and social impacts of planned sector investments and rehabilitation activities in the urban areas;
- In light of the available information, develop an environmental and social screening process for the future rehabilitation and construction activities referred to above; and,
- Prepare an Environmental and Social Management / Monitoring Plan (ESMP), including monitoring indicators, for the UWSSP.

2.5.2 Resettlement Policy Framework (RPF)

The main objective of this RPF is to ensure adequate management of the land acquisition process following the World Bank Operational Policy as well as the country's legal requirements and provide guidance for the preparation and implementation of Resettlement Action Plans (RAP) for the subprojects of the UWSSP II. This RPF aims to ensure that any possible adverse impacts of proposed project activities are addressed through appropriate mitigation measures. It addresses issues of land acquisition, loss of property or access, or more of livelihoods resulting from the implementation of waste water treatment plant, public and communal toilets, trunk line and a pipe line and in some cases access roads under the proposed project.

2.6 Administrative and Institutional Framework

The FDRE Environmental Protection Authority (FEPA) is an autonomous public institution of the Federal Government of Ethiopia entrusted with the protection and conservation of natural resources in Ethiopia. The general role of the FEPA is to provide for the protection and conservation of the broad environment, through the formulation of policies, strategies, laws, and standards, which foster social and economic development in a manner that enhances the

welfare of humans and the safety of the environment. Following the principles of government decentralization, each national regional state shall establish an independent Regional Environmental Agency or designate an existing agency that shall, based on the Ethiopian Environmental Policy and Conservation Strategy and ensuring public participation in the decision-making process, be responsible for Coordinating the formulation, implementation, review, and revision of regional Environmental monitoring, protection, and regulation.

2.7 SER Environmental Protection Authority

SEP Environmental Protection Authority (REPA) is responsible for environmental protection matters in the region. It has the mandate of enacting regional environmental proclamations, regulations, standards, and guidelines. The REPA is responsible for the review and approval of ESIA of development proposals under the mandate of the Regional Government. The review and approval of the current ESIA for the FSTP is the responsibility of REPA. It is also mandated to follow up construction and execution of the project at least on semiannual basis. It can conduct environmental and social safeguard audits every two years and give technical assistance and guidance to the zone and city administration environmental regulatory agencies.

2.8 Wolaita Zone Environmental Protection Office

Wolaita Zone Environmental protection Office (WEPO) is mandated to ensure concerned stakeholder involvement in the FSTP planning, construction, and operation. And community follow-up of the implementation of ESIA recommendations of such proposals becomes a joint responsibility of regional and Zone EPA. Zone EPA should follow up every quarter and compile progress reportss forfor the regional EPA. The regional EPA at least should visit twice per year and give written feedback to the developer. Therefore, project proponents in the Region should operate in close cooperation with both the regional and Zone EPA to ensure that the adverse environmental and social effects of development proposals are properly identified and their mitigation or management actions incorporated in the project design, planning, and implemented at the right time.

3. ESIA Approach and Methods

3.1 Approach/Design

The ESIA study requires the collection and evaluation of comprehensive socioeconomic and environmental data. In line with the type of assessment being conducted and, the nature of data sources being collected, the mixed assessment method was selected as the best approach. This mixed approach method was selected because the assessment was relatively complex and requires a more comprehensive understanding of the phenomenon being studied. Following the EIA guideline of Ethiopia, the GSEMC utilized both quantitative (numerical) and qualitative (non-numerical) data from primary and secondary sources.

The obtained environmental and socioeconomic data are described, and explained at the required scale. Description of data preferred to assess the impact of the project on receiving biophysical, socio-cultural, and economic environment as they are on the ground. Descriptive assessment design sets out to describe and interpret what is. It looks at individuals, groups, institutions, methods, and materials to describe, compare, classify, analyze, and interpret the entities and the events that constitute the various fields of inquiry. Moreover, as a supplement explanatory design was given by professionals when elaboration and enrichment of socioeconomic, cultural, and environmental issues on the ground.

3.2 Period of Field Data Collection and Site Visits

The required field data from WST was collected from May 18 –June 4 /2023. A team of experts participated in the collection of information from the public, stakeholders, project owners, experts, sample analysis, and proposed project sites.

3.3 Assessment Method

The ESIA method comprises a wide variety of methods. Information related to the biophysical, socio-cultural, and economic environment of the proposed project was collected exclusively on environmental safety, social acceptance, and economic viability as key points of project implementation. Moreover, data related to vulnerable groups' management, land acquisition, access to job opportunities, compensation, relocation, and infrastructure facilities were also collected and examined. ESIA typically involves a range of methods including scoping, baseline studies, stakeholder engagement, impact prediction, impact assessment, risk assessment, mitigation measures, monitoring, and evaluation.

Scoping: Scoping tools used for identifying potentially significant social-environmental impacts of the proposed project are presented. This involves detecting the environmental components that might be affected by the project, such as air, water, soil, ecology, human health, and cultural heritage.

Baseline studies: Baseline data collection was one source of information that involves collecting data on the current environmental and social conditions like data on the physical, biological, and social environment, as well as information on the existing land use, infrastructure, and other activities in the project area. This method is used to establish a baseline against which the potential impacts of the project can be compared.

Impact and risk assessment: Impact assessment covers identifying and assessing the potential environmental, and social impacts of the project. Impact and risk assessments are conducted using various methods, such as Screening, Checklists, Matrix methods, and Expert judgment.

- Checklists are also used as a method to list potential environmental impacts that may be caused by the proposed project. The checklist is used to identify potential impacts and to determine the scope of the impact assessment.
- The matrix assessment method is also applied for assessing the potential environmental impacts of a project and to evaluate the significance of the impacts.
- The expert judgment is also utilized which consists of obtaining the opinions of experts in relevant fields, such as ecologists, hydrologists, environmentalists, sociologists, and others to assess the potential environmental impacts of the proposed project.
- Geographic Information System (GIS) mapping is one of the methods applied for visualizing and analyzing spatial data. GIS is used to identify and delineate areas that may be sensitive to the potential environmental impacts of the proposed project.

Stakeholder engagement: individuals or groups who may be affected by the proposed project or who have an interest or may be affected by the project consulted. This method is applied to assess the stakeholder's interests and obtain their values, concerns, and perspectives on the proposed project and its potential environmental impacts.

Mitigation measures are employed method to reduce or avoid the potential environmental impacts of the project done by mitigation measures. Project alternatives change to the project design modifications, use of alternative technologies, or operational measures.

Monitoring and evaluation: Monitoring and evaluation methods include developing a plan to monitor and evaluate the environmental and social impacts of the project over time.

3.4 Sources of Data

Project-linked data sources were obtained from both primary and secondary data sources. The primary data sources used were structured surveys, experiments, and observation while secondary data sources were obtained from government statistics, institution reports, academic research, public records, and others.

The type of data collected comprises qualitative and quantitative ones. Qualitative assessment methods involve collecting non-numerical data from Key Informant Interviews (KII), observations, or open-ended survey responses. This assessment method is typically used when the required information, involves Focus group discussions (FGD), exploring people's experiences, opinions, or attitudes towards an FSTP, Communal and Public toilets. The quantitative approach addresses data collected through survey (questionnaire) and experimental (environmental samples) methods.

Field Surveys: A field survey was conducted to collect new information on the environmental setting, baseline conditions, and potential impacts associated with the proposed project. Depending on the parameters measured and project requirements, one can apply various field survey methods for the Environmental Impact Assessment (EIA) process. Collecting physical, chemical, and biological data from the project site and surrounding areas was done by using direct observation, sampling, Stakeholder engagement, and Geographical Information Systems (GIS) remote sensing.

Documents, Policies, and Guidelines review: Secondary data sources can provide valuable information on the environmental setting, baseline conditions, and potential impacts associated with the proposed project. A review of relevant documents, policies, and guidelines was conducted to ensure that the proposed project complies with the legal and regulatory framework. Among others, some of the reviewed documents comprise the feasibility study and design of the proposed project, country Laws, policies, WB safeguard policies, guidelines, government reports, academic publications, and others were reviewed.

3. 5 Data Collection Tools

Data collection tools are instruments or methods used to collect data from primary or secondary data sources. City-wide socioeconomic environmental data was collected by pre-developed data collection instruments. The data collection instruments are presented as follows.

3.5.1 Survey

Surveys are questionnaires or interviews designed to collect large amounts of data at a particular point in time. Surveys are vital to describe the nature of existing conditions, to identify standards, determine the relationships of specific events. Thus, to acquire appropriate information about the existing situation of the physical, social, and cultural environment, and institutional-level survey was done by using a questionnaire. The office data collection questionnaire dealt with demographic characteristics, human resources and capital, natural resources, and settings, infrastructural facilities of the city, and cultural and economic resources within and around the project site as a receiving environment.

3.5.2 Public Consultation Checklist:

Public consultation was one form of data collection tool. Representatives of local government (Kebele), community members composed of elders, the youth, women, religious leaders, and vulnerable community groups which are found nearby of the project site were engaged in this event. Consultation was held by using a checklist and data related to public views, concerns, questions, and comments of local communities documented through minutes. The consultation was freely carried out without any persuasion or interference to push the interests of the consultant.

3.5.3 Focus Group Discussion (FGD):

FGD was another data collection tool which included participants between 8 and 12 individuals. The moderator was responsible for asking open-ended questions and guiding the discussion. Focus group discussions can be particularly useful for gaining insights into complex or sensitive topics, where individual perspectives and interactions among participants can provide a deeper understanding of the issues at hand. Discussions were made on particular issues and informations documents though Minutes. FGD was conducted in most proposed public and or communal toilets and stakeholders.

3.5.4 Key Informant Interview (KII):

The KII method is used to collect in-depth data on a particular topic or issue by interviewing an individual who has specialized knowledge or experience relevant to the research question. Project-related semi-structured question items were prepared for the interviewee. Data was collected by a semi-structured interview guide, which includes a list of open-ended questions designed to elicit detailed information on the topic of interest. Semi-structured interview items have flexibility advantages in which new questions could be forwarded during the interview based on the responses of the interviewee.

3.5.5 Informal Interview Guideline

Another data collection tool used in this study was a spontaneous and on-site informal interview using a guideline during field visits. Though this tool, informative and suggestive data about individuals, local communities, households, kebele, and city officials was collected.

3.5.6 Observation

Observations are typically conducted in a natural environmental setting, such as project sites workplaces or communities. Direct observation involves visually inspecting the project site and surrounding areas to identify potential environmental impacts. This may involve documenting the presence of sensitive ecosystems, wildlife habitats, or cultural heritage sites. By using experts' keen observation, GSEMC assessed the social settings, physical characteristics, economic activities, environmental features, plants, and crops found in and around the proposed project sites. The observation activities were also supported by taking photographs and video recordings.

3.5.7 Hand-Held GPS

A global positioning system (GPS) (Model: GPS Map 76 CSx) Hand, GPS used to collect (X, Y) coordinate points of the study site and development of GIS-based maps. GPS coordinates are collected at site-level investigation points for the identification of location features and to ensure accurate mapping, analysis, and visualization of environmental parameter data. Remote sensing is also applied by using satellite imagery technologies to gather information on the project site and surrounding areas. This method is utilized for identifying land use patterns, vegetation cover, or other environmental features. The collected data was analyzed using various software tools, including ArcGIS for preparing different maps, using DEM 12.5X12.5m by Sulfer software for preparing 3-D geomorphological maps, and other software for data analysis and visualization.

Data collected for the hydrogeological and geological maps involved office-level analysis and site-level investigations. Office-level analysis focused on reviewing existing maps and data sources to identify key features of the hydrogeological and geological formations in the catchment area. While site-level investigations involved collecting detailed information on the hydrogeological and geological formations at specific locations within the catchment area.

3.5.8 Water Physico-chemical Quality Testing

Sampling involves collecting water samples to assess the baseline environmental conditions or potential impacts associated with the proposed project. A sterilized sample bottle was used to

collect water samples from rivers in and around the proposed project sites. Before sampling, sample collection containers were properly cleansed with distilled water and rinsed with the sample water. After a brief flow for two – three minutes, groundwater samples were taken. Before water sample analysis, testing instruments were calibrated by using calibrating solutions supplied by the company. In situ (on-site) physicochemical analysis for temperature, pH, Total dissolved solid (TDS), and Electrical Conductivity (EC) done by using portable TechPro II™ Series Model THP1 (MYRON L® COMPANY USA) following the guidelines of the instrument manual.

Furthermore, other physicochemical parameters like Nitrite, Sulphate, Potassium, Iron, Phosphate, Ammonia, Fluoride, and Total alkalinity were measured Ex situ (in the laboratory by using Wagtech WTD Palintest Photometer 7100 at Dilla University research laboratory.

3.6 Impact Identification and analysis

The type and sources of collected data greatly vary according to the analysis. Analysis was done through the evaluation of the baseline conditions, risk assessment, stakeholder analysis, and information triangulated to see their associations.

Stakeholder analysis comprises identifying and analyzing the interests, values, and concerns of stakeholders who may be affected by the project. For each identified impact risk assessment was done through quantifying the likelihood and severity of potential environmental, social, and health impacts of the project. The significance of the predicted or identified impacts has been quantified and evaluated by considering the magnitude of the effect and the sensitivity, value, and importance of the affected resource or receptor. For the quantification and evaluation of impacts checklists and interaction matrices were applied. Each major impact is evaluated using the criteria assigned by experts' professional judgment based on the impact intensity, extent, duration, and sensitivity of the receiving biophysical and socio-cultural environment. After evaluation of impacts, appropriate and justified mitigation measures for the negative impacts and enhancement measures for the positive impacts are forwarded.

The collected baseline data was encoded SPSS (Statistical Package for the Social Sciences) a software package (IBM, SPSS Inc model 20). Information analyzed and thus, data interpretation was made with the help of simple statistics like mean, maximum, minimum, frequency, and percentage which are presented in Tables, figures, pictures, and charts.

4. Description of the Proposed Development Subproject

In this section the overall description of proposed development is presented. The subprojects include the Fecal Sludge Treatment Plant (FSTP), and communal and public toilets.

4.1. Project area description

The project is implemented in WST. The city is found 383 Km South of Addis Ababa the nation's capital. Geographically, the city is situated between 6°45'00'' and 7°0'00''N and between 37°35'00'' and 37°53'00''E. The proposed project includes the development of 28 public toilets, 30 communal toilets, and a fecal sludge treatment plant. The location map of FSTP and public and communal toilets is presented in (Figure 1).

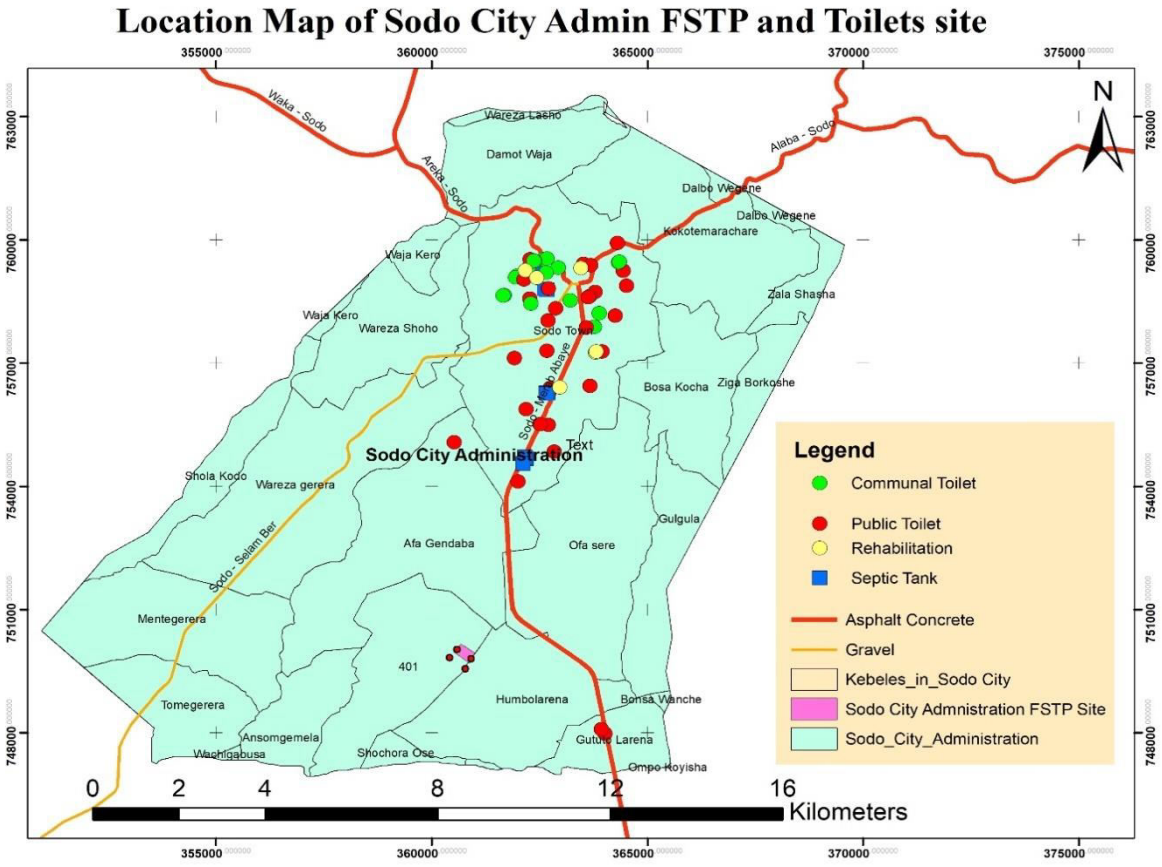

Figure 1 Proposed public, communal toilets and FSTP at WST.

4.2 Fecal Sludge Treatment Plant

For medium-term intervention new FSTP is proposed to be built in Wolaita Sodo at Larena Amba rural Kebele which was recently incorporated under the town boundary. The proposed FSTP is geographically located between 06°47'01.37" N and 37°44'33.06" E and has an elevation of 1769m. The area is situated southwest of the WST center, almost two kilometers west of main Sodo to Arba Minch Asphalt road.

The slope of the area is almost 0 and it is a much leveled surface land that is practically flat. The proposed area has different land use forms. The majority of the area is covered *with* Eucalyptus trees and the plantation has been done since 1974 E.C. Currently the Eucalyptus forest is owned and managed by the town's Environmental Protection Office. The office periodically sells *Eucalyptus* trees that are mature enough for logging. Some part of the area is used by communities as grazing land for their cattle and collect fire wood. Some agricultural land areas are also found in the south and north.

The area is suitable for investment and hence some investors are taking lands in the surrounding. For instance, a meat processing plant to the east is under construction. The proposed site is located at the periphery of the city, far from residential areas and found within the area which is designated as an industry zone. The proposed FSTP construction site is found within the proximity of Ethio- Kenya 500 kilovolts (kV) electricity transmission line infrastructure.

Moreover, the FSTP proposed site has significant ground water potential. The proposed site is found in a low-lying section of the town and the available shallow and medium-depth groundwater is currently used as a source of potable water. The partial view of the project site is presented in figure (2).

Figure 2 Partial view of FSTP location in WST

Access Road infrastructure: The proposed location has no access road in the area hence, construction of an access road (1.5 to 2 km) is expected before the beginning of subproject activities. For the construction and operation phases of the sub-project, access roads are vital components. Similarly in the operation phase, roads for vacuum trucks are required for transporting fecal wastes from septic tanks and toilets to FSTP.

For the functionality and sustainability of the project, access road with about 1.5-2Km length from the nearest Asphalt road has to be developed. The access road must be designed, and constructed in such a way to accommodate vacuum trucks and other heavy-duty vehicles that transport construction materials, and fecal sludge to the plant. The development of access road to this particular site may result negative impacts to the environment that includes soil erosion, air and water pollution, climate change, and so forth.

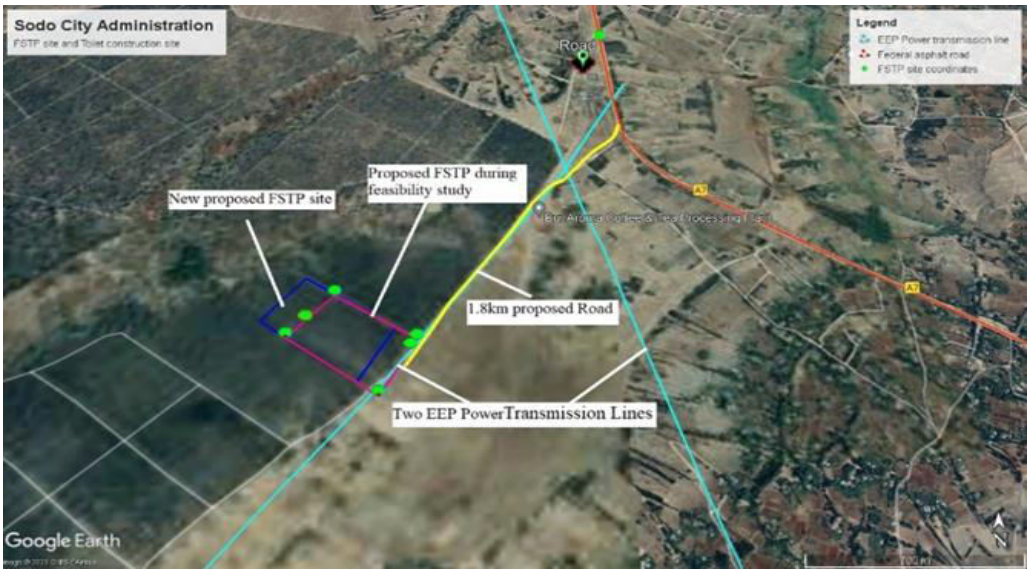

Figure 3 Proposed access road for the FSTP WSC

4.2.1 Fecal Sludge Treatment Plant capacity

The capacity of FSTP considers both medium and long-term intervention and the worst-case scenario. Hence, the design outlines the maximum treatment capacity of the project anticipated as 83.8 m^3/day and 77.8 m^3/day of fecal sludge during the dry season and rainy season respectively.

The proposed full FSTP will be comprised of interconnected working units of septage receiving and screening units, Settling – thickening tanks, Sludge drying beds, Flow equalization tank and pumping station, an Anaerobic baffled reactor, Wetlands feeding pumping station, Constructed Wetland. The treatment technology is capable of treating the fecal sludge at the required level. For treated wastewater, the disposal standards of the effluent quality parameters have to follow Ethiopian discharge limit standards. The treated fecal sludge effluent has to have pH (6-9), BOD (30mg/L), COD (125mg/L), Oil and grease (10mg/L), Total suspended solids (30mg/L), total Nitrogen (15mg/L), Total coliforms (400CFU/100mL).

To reuse the dried fecal sludge, further treatment (mixing with lime) is necessary to eliminate pathogens in the dried sludge. Leachate that has been collected from drying beds and drained through them has to undergo further treatment, aerobic baffle tank reactor (ABR), waste stabilization ponds, or wetlands before it can be disposed of or utilized properly.

5. Public Consultation

5.1 Stakeholders Consultation

As part of the ESIA study stakeholder consultations were held over proposed projects. Two types of public consultation were held in the town. The first consultation was conducted on 24th May 2023 at WSCWSS's office. After identifying the stakeholders GSEMC invited representative nine stakeholders but WS City's Environmental Protection office; Ethio-Telecom, and Education Offices actively participated in the PC. Moreover, community consultations were also held with amiable community members who were relatively the nearest neighboring community for the proposed FSTP site.

The first consultation was made as an entry meeting with the Wolaita Sodo town Water supply and Sewerage enterprise. During the entry meeting the General Manager of Wolaita Sodo's Water supply and sewerage enterprise and UWSSP-II coordinator, experts were participatory. They informed us that preliminary preparations for the implementation of the project have already been completed and are happy to cooperate and engage in the required activity of the ESIA study. They need to see the implementation of the project as soon as possible. Land for the FSTP was secured, social and environmental safeguard experts were recruited and they are waiting for the implementation of the project. They requested the consultant team to complete the ESIA study as soon as possible. The partial view of the community consultations is presented in figure (4).

Figure 4 Partial view of entry meeting at WSTWSSE

The second consultation was conducted in the form of FGD with representatives of relevant sector offices in the town. Some of the key issues discussed during this meeting were

- The town is expanding "as the city grows and expands it is inevitable that people will be settling around the site selected for FSTP construction. So, did the study design have to take this into account?" (participant from town Education office).

- The proposed project sites are already selected, So from an environmental protection point of view, it is difficult for me to provide any positive or negative opinions on the sites selected for subproject construction." "the area is near to the city and people are also acquiring land for residential purposes in the area. Will not this cause problems in the future? It is known that the investment cost of the project is very huge, so, it will be better to build such huge investment projects in the farthest place." (participant from town EPA).
- We don't know the selected sites "we would have been able to provide our opinions over the sites had we been invited before their selection. Yet we don't know where the sites were selected so it is difficult to speak whether these sites are located closer to our properties or not. However, more than 80% of our properties are found underground; so if you let to know where these sites are before beginning construction, we will give our opinions and it will also save time and resources." (participant from Ethio-Telecon).

Table 3 Summary of issues raised during stakeholders' consultation

No	Issues raised	Responses given
1	Whether the FSTP site selection process was informed by the study or not and has considered the future growth	As FSTP design and feasibility study were conducted before the ESIA study; and the current ESIA is also part of studies that identify subprojects' potential impacts on environment and social aspects
2	Whether site selection considered the future growth and expansion of the city or not	The site was selected according to the latest revised master plan of the city; and the selected site was selected together with and approved by the Municipality of the city
3	On the importance of creating a working relations with stakeholders for the future	WSCWSSO promised to inform and engage stakeholders and closely work with them
4	Whether stakeholders will be informed of the whereabouts of selected sites before the beginning of construction works or not	WSCSSO promised to provide the GPs with coordinate points of sites as well as to show them personally

Results of Stakeholders Consultation: All participants described that the Utility Enterprise did not inform them about the proposed FSTP construction and other UWSSP-II subproject components. Nor they have participated during project design and site selection processes and

they have recommended the importance of coordinating activities among themselves and described their willingness to provide their professional opinions and to closely work together during project implementation time and in any of the future projects planned by the enterprise in the town. The above stakeholders' views clearly show the lack of stakeholders' involvement during project design and site selection. Hence, the consultant team strongly recommends the Utility organization should engage and coordinate its activities with key stakeholders during subproject implementation and operation phases.

5.2 Tripartite discussion among Stakeholders

The main objective or agenda of the meeting was to reach a consensus on the technology and site alternatives for the proposed FSTP. For these purposes tripartite discussion was conducted virtually as well as face-to-face participation on 13th October 2023. The participants were the client (MoWE), ESIA consulting team members, and representatives of the design consultants for Arba Minch Woalita Sodo, Nekemete, Jimma, Assela, and Shsashemene towns. A total of 19 (two female) individuals were involved in the tripartite discussion. The proposed technology alternatives by the design consultant are also suitable for the town and effective in treating the generated fecal sludge a sustainably and achieving the UWSSP-II project objectives.

Hence ESIA consultants also agreed and do not have any reservation for the selected FSTP technology options and design parameters considered for the implementation of the Project. Moreover, for the selected project site (alternative one), ESIA consultants have some reservations and suggested shifting the project site location some 200m toward the Waste direction. This is because the selected project site is found nearby of Ethio-Kenya High voltage electric transmission line which necessitates shifting or amendment of the project site. Shifting of the project site does not require any design change and has similar socioeconomic and environmental impact. Hence, the design consultant considered the raised issue and agreed on the shifting of the site location as suggested by the ESIA consultants.

Table 4 Summary of Tripartite discussion raised issues Addis Ababa

Issues raised	Responses /agreements
• Design of FSTP Technology alternatives • Shifting of the Selected site(alternative1) 200m towards west	• The design of FSTP alternatives considers practicability, requirements, and environmental and social issues besides the expected waste treatment efficiency. ESIA team accepts the proposed technology option as environmentally friendly and feasible from in economic and technological perspective. Agreed on the implementation of the project design recommended. • The selected project site is found nearby of Ethio- Kenya high voltage electric transmission line. So, ESIA consultants have some reservations and suggested shifting the project site location some 200m toward the West direction. The design consultant agreed on the issue as far as there is no any on the technology alternative

5.3. Community Consultation

The area proposed for the construction of FSTP in Woliata Sodo town is found inside the Eucalyptus tree forest which is located far from settlement areas. Although no people are living adjacent or near the proposed construction site, this study has conducted public consultations with security guards of the forest, with youths who have been looking after cattle and collecting fire wood during the site visits and members of the upstream neighboring community who are living in relative proximity to the project area.

The consultant team has organized six guiding questions and these questions are posed to participants step by step to seek any opinions, questions, and concerns they may have over the proposed FSTP project in the area. The questions raised for consultations generally fall into three themes: They are also encouraged to express their feelings openly using any language they are comfortable with.

1. Whether PC, community sensitization over sanitation practices, and participation during planning and site selection of the proposed FSTP project was undertaken or not;
2. Whether there is an ownership claim over the site selected for a proposed project or not;
3. Community members' expectations and their reflections on the proposed project.

The main issues, opinions, concerns, and questions expressed by participants during PCs are presented below.

Participants' responses on the undertaking of prior PC on proposed FSTP project in the area

The first question forwarded by the consultant team for discussion was whether or not a prior PC was held during site selection for the proposed FSTP construction project in the area. Their responses are as follows:

- The administrator of the sub-city described that, "the government beginning from the Federal one is introducing several development projects in Wolaita City; but the projects would be successful and sustainable if they were proposed in consultation with the community.
- A person working as a security guard in the forest said, "Even though we do not know the type of project planned to be constructed in the area, we have been watching people from the government surveying the area and burying boundary stone in the area. They simply told us that the area is needed for a project. This is what we know." Another security guard said, "I know him (referring to the focal person from the WSWSSE) and I was there when a construction site was selected for the project and he also informed us about the proposed project which is going to be built in the area.

Figure 5 Community consultation at Larena Amba Kebele WST

Participants' responses on the undertaking community mobilization and awareness creation programs on the UWSSP-II FSTP project

PC participant's response on whether community mobilization and awareness creation on UWSSP-II FSTP project undertaken or not. PC participants' response to this question was a resounding "No"

Participants' responses on community representatives' participation during project planning and site selection

Participants of PC replied that no one from their locality has participated during project planning and site selection. One of the participants of PC informed that,

- "Before today, no consultation was held with the community and none of us have participated during site selection for the project. However, its implementation will benefit us. Therefore, we give our consent to it."

Participants' responses on ownership and uses of land selected for construction of FSTP

The participants have described that the land selected for construction of FSTP is a state-owned forest land and they replied that neither themselves nor any members of the community have ownership claim over it. Some of their responses on the current land uses of the selected site include:

- "Although there are some tracts of privately owned land in and around the site selected for the project, it is located inside a state-owned forest. So, it does not affect private property.
- "the site selected for the project is found inside a state-owned forest and part of it is communal land. Some individuals hold private land and eucalyptus trees. Identifying and managing these issues should be worked out before the beginning of project construction."
- "there is a vast size of communal grazing land and there are also private land owners with title deeds. Thus, these people should be protected from damage."

Participants' responses on the existence of cultural, religious, historical, or archeological artifacts on the proposed FSTP site

- One of the participant commented that "the surrounding area of the project site is a pasture land for cattle and a playing ground for children, precaution must be given to

these places to protect them from pollution. In addition, the project site is located inside a forest area and the project's presence in a forest will protect the forest itself."

- Another participant also refelects on environmental concern "There is a tendency to transport waste materials and dump them inappropriately in the area. A prompt construction and operation of the project will render us from these illegal waste materials."

Participants' responses on their expectations from; and reflections; on the proposed project implementation

- Participants of the discussion said, "There have been several similar projects about the advent of projects into our area but they never materialized. They pledge their implementations but not deliver as promised." He questions, "to what extent can we be certain about the current project? He adds, "The project could benefit us in different ways; so we want to know if this is a real one or not." Beside Ato Gezume Ayeda recommended that "If the project affects private property, I urge project affected people should be compensated in a culturally appropriate way."
- The second given response was related to project benefits "We will highly benefit from the project; we will benefit from fertilizers product which will be produced by the project." "The project will bring several important benefits. We will get fertilizers from the project; lack of fertilizer is one of the main problems in the area and the project will support us in this regard."
- The third person said "Projects are not implemented according to promises made; we have been frustrated a lot by broken promises. We expect this project to be different from the previous one. It is we who will benefit from the project and we also believe that the coming generation will benefit from it. So, we urge its immediate and proper implementation as soon as possible. We are happy about the proposed project."

Table 5 Summary of main issues that rose during community consultation

No	Main Issues Raised by participants	Responses given
1	The existence of private properties around the proposed FSTP site;	Both the consultant team and the representative of Water Utility assured them that: • The land is explicitly expropriated from public land; • A border stone marking its boundary is already erected and • Invited consultation participants to see and approve it by themselves
2	The need to protect grazing land and children's playing ground	Both the consultant team and the representative of Water Utility informed them that • Only five-hectare of land is required for the project and • The remaining areas will continue serving their usual purposes
3	How the proposed FSTP subproject is different from other unfinished government projects in the area?	Both the consultant team and the representative of Water Utility described that • The source of funds for the current subproject is WB; • Construction begins immediately after the completion of this ESIA study • Upon WB's approval of the subproject
4	The importance of hiring unemployed youths during project construction	Both the consultant team and the representative of Water Utility described that • The Water Utility Enterprise will work with the Contractors to prioritize youths and other interested people from the areas while hiring labor

Results of consultation: (1) Participants of consultation indicated that prior community consultation was not conducted on the proposed FSTP project and no one representing their community has participated during project planning and site selection phases of the project, and the water utility enterprise did not organize any awareness creation and community mobilization programs about the UWSSP-II in general and the proposed subproject in particular. (2) Another result of the consultation is participants unanimously explained that the proposed FSTP site is a state-owned land; hence no one in the area has ownership claim over it. Yet, they suggested that private properties such as land and eucalyptus trees that are found around the project area should be protected from any damage and the provision of culturally appropriate compensation if there are people affected by the project. (3) Participants of the consultation also described the absence of physical cultural resources that have historical, cultural, religious, or archeological significance in the area. (4) Lastly, they have given their full support to the proposed FSTP project and they urged to accelerate implementation of the subproject.

6. Biophysical and Socio-Economic Baseline Information

Sustainable development interventions like improved sanitation and hygiene system in which every urban and peri-urban citizen benefit from adequate sanitation service delivery, need a clear understanding of the biophysical and socio-economic condition of the area that a project covers. Biophysical and socio-economic background information provides a clue to understanding social interaction with its environment in day-to-day activities and economic conditions within the City. Biophysical and socio-economic information required for this specific study is location of the project area and its relief, topography, climate (rainfall and temperature), wind speed and direction, literacy level, economic situation, administrative and political situation, housing pattern and its quality, livelihood source including the source of drinking water, health status e.t.c. will be thoroughly examined.

6.1 Location of WST

Wolayta Sodo, one of the rapidly increasing Cities in the southern corridor, is located 330 km from Addis Ababa via the Addis-Butajira-Halaba route and 125km from Hawassa City of Sidama Regional State via the Hawassa-Morocho-Dimtu route. Astronomically, the city is located 6.49^{o} north and 37.45^{o} east. Relatively, the study city is located west of the Great Ethiopian rift valley & and at the eastern margin of the south western highlands. The city was established in 1952 E.C. at the foot of mount Damota and from this mountain; its altitude descends in all directions. The relief of the city is mainly characterized by mountains, gorges, and plain lands, especially towards the southern direction.

The highest & and lowest altitude of the city ranges from 1738 - 2831 meters above sea level. According to the information stated on the five-year strategic plan of the municipality, the total area of the city is about 16,381 hectares, divided into 7 new Kebele administrations (woreda), and 19 ketenas (including newly added rural kebeles).

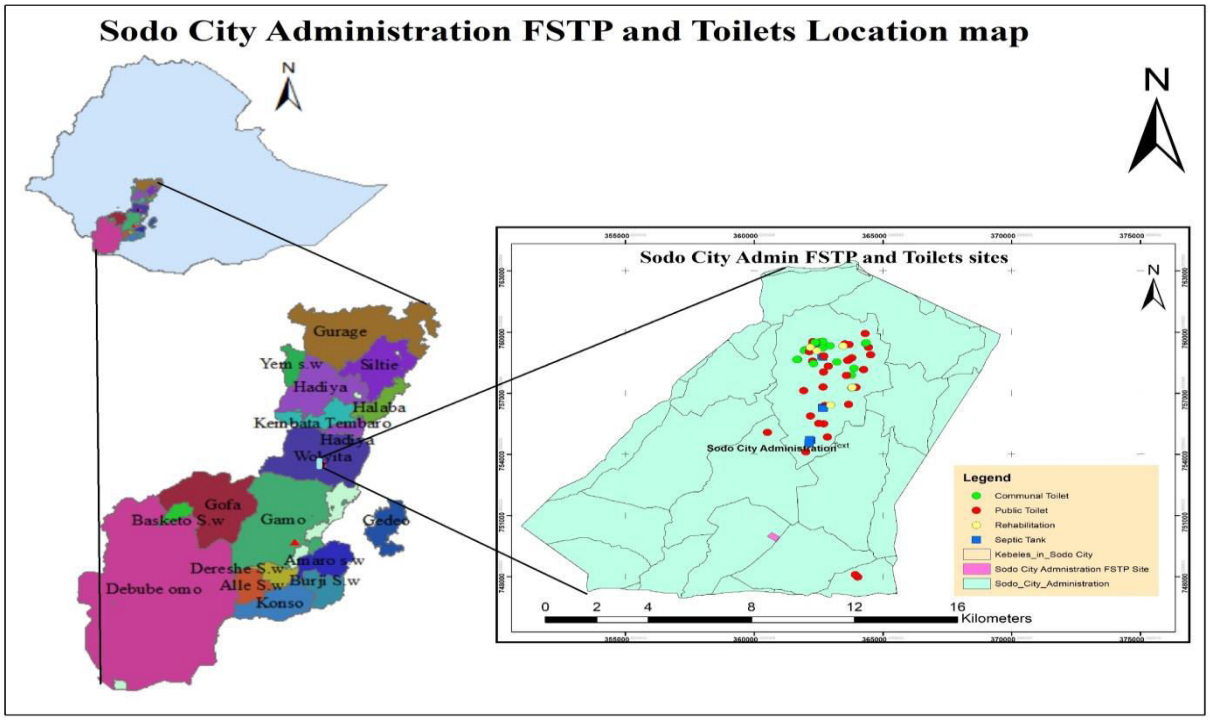

Figure 6 Location Map of WST

6.2 Abiotic Environment

6.2.1 **Climate**

The city is established at the foot of mount Damota and from this mountain, its altitude descends toward in all directions. The relief of the city is mainly characterized by mountains, gorges, and plain lands, especially towards the southern direction. Regarding the climate, the limiting parameter of the net primary production potential of the Wolaita Sodo area is precipitation with 1762 grams of dry matter per square meter per year compared with 2226 grams of dry matter per square meter per year potential for temperature, (Koeppen, 1936).

6.2.2 Annual Rainfall

The analysis of 33 years rainfall record of WST realizes a non-significant increasing trend. The maximum annual rainfall of 1500 mm was obtained in 1996 and a minimum of 711.9 mm was recorded in 2015 in the last 3 decades. The increasing trends of annual rainfall amount in east Africa is consistent with global and regional precipitation projections for the future regardless of its distribution and seasonality. However, the increment is due to increased rainfall amount in short periods which may lead to flooding and landslides in areas already vulnerable to such disasters. The figure below shows the rainfall trends of WST.

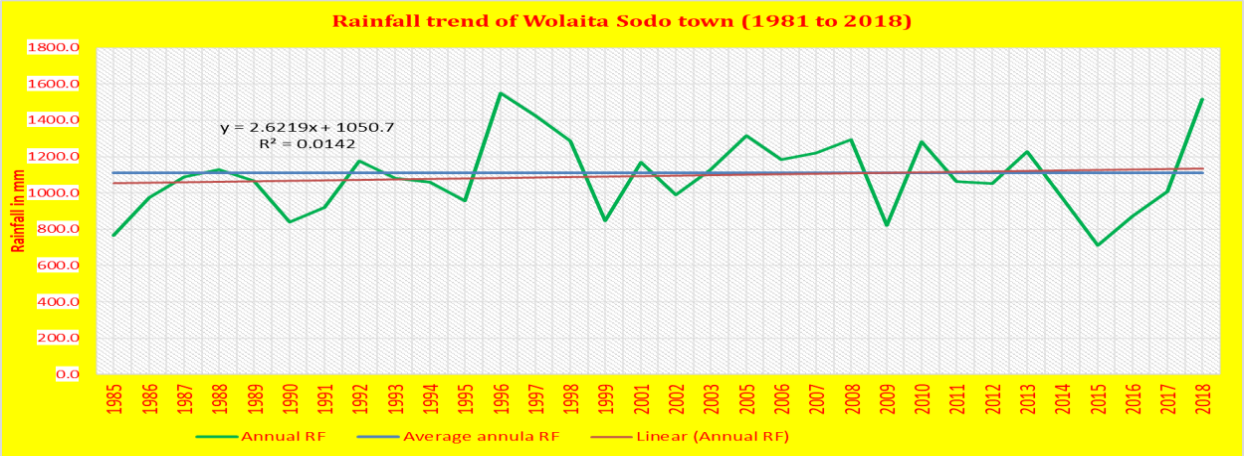

Figure 7 Rainfall trends of WST

Data Source: NMA, Ethiopia (2020)

6.2.3 Temperature

The average temperature of WST is showing increasing trends with a coefficient of determination (r^2) of 26.81%. In the period between 1981 and 2018, the maximum temperature range was 2.4^{o}c with the evidence that a maximum temperature. The minimum temperature record also shows a range of 7.5^{o}c in the last 3 to 4 decades in WST. The increasing temperature will result in high evapotranspiration leading to a shortage of water availability for different uses and purposes in the city.

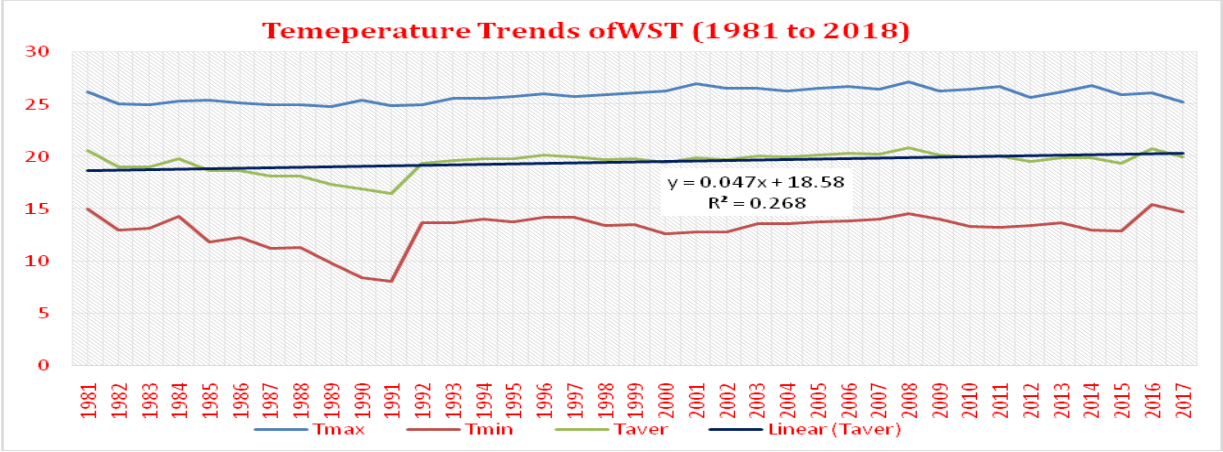

Figure 8 Temperature trend of WST.

Data Source: NMA, Ethiopia (2020)

6.2.4 Monthly Climate Features

The mean annual temperature of Sodo town is 19.93^{o}c with a maximum temperature of 29.7^{o}c in February and a minimum of 12.1^{o}c in August. The precipitation pattern of the area is mono-modal usually commencing in March and extending to October with peak rainfall of about 218 mm on average in July. The monthly average is 111 mm and the total annual rainfall is 1333 mm.

Regarding potential evapotranspiration of the area, it is almost lower than the actual precipitation for the months between April and mid of October which indicates the presence of adequate moisture for any bio-degradation processes in these months. The potential evapotranspiration is as high as 136.8 mm per month in March which can be directly attributed to the maximum wind speed and high temperature in this month. The monthly average PET is 108.7 mm with an annual total of 1304 mm.

Table 6 Climatic Characteristics of Wolaita Sodo town

Climate Variables	**Unit**	**Max**	**Min**	**Average**
Temperature	^{o}c	29.7	12.1	19.93
Rainfall	mm/month	218	26	111.08
Potential evapotranspiration	mm/month	136.8	84	108.6
Wind speed	Km/h	7.2	2.88	4.26

Source: FAO NewLocClim_10)

6.2.5 Wind Speed and Direction

According to Wolaita Sodo University (2019), the prevalent wind direction of WSC is Northeasterly which flows from Northeast to Southwest. As per the data obtained from FAO NewLocClim 10 databases, the average annual wind speed of the town ranges between 2.88 km/h in November and December and 7.2 km/h in March with an annual average of 4.26 Km/h.

6.2.6 Humidity

Humidity is the presence of water vapor in the atmosphere. The more water evaporates in a given area mean that the more water vapor rises into the air, and the higher the humidity of that area is. Hot places tend to be more humid than cool places because heat causes water to evaporate faster. According to the CLIMWAT2.0 tool of FAO (2006), the annual average humidity of WSC is 71%. The maximum humidity is recorded at about 81% in October and the minimum is recorded at 58% in December.

6.3 Geomorphology of the Study Area

The geomorphological setting of Sodo town is characterized by the highland Damota Mountain, with an elevation of 2980m, while Sodo town is located near a ridge with an elevation of 2086m. The study area of the fecal sludge site has an elevation of 1770m and is characterized by a plateau that often forms separate high flatlands. These plateaus are located in the south-central parts of the study area. The surface of the plateau in the northing direction of the fecal sludge site has been separated by erosion into many closely spaced gorges. This topography is formed by an intricate drainage system, including the dry Abiya River, and the slope of the fecal sludge is almost 0-2 %.

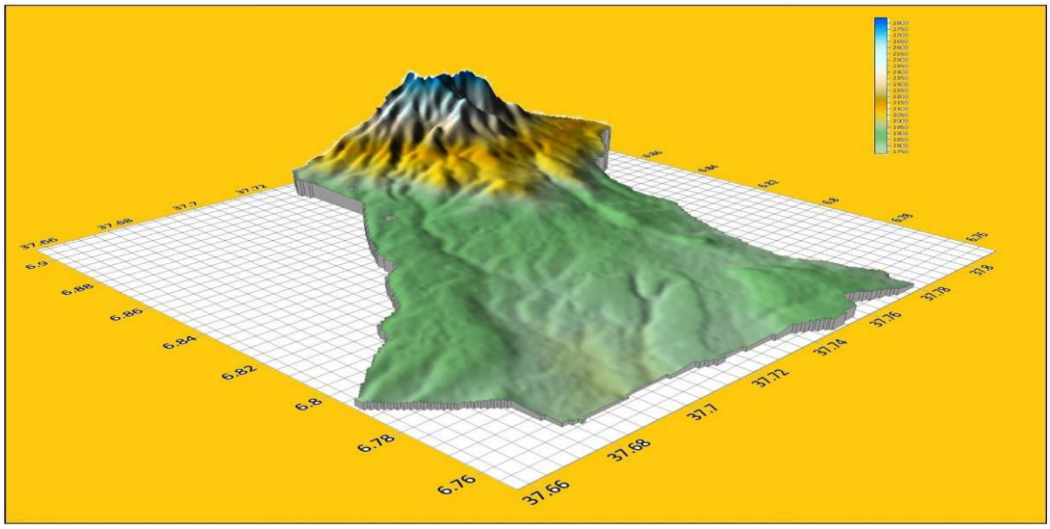

Figure 9 Geomorphological setting of WST

6.3.1 Slope WSC

The slope percentage of the Sodo town Fecal Sludge treatment site varies from 0 to 30%. This suggests that there is a wide range of slopes in the area, which can have implications for the stability of infrastructure projects like the Fecal Sludge site. Based on the slope percentage, the study area has been reclassified into fives slope classes, and the fecal sludge treatment the slope result is flat to vary gently. It would be helpful to know more about the slope classes and how they are defined. Understanding the slope characteristics of the area can be important for planning and designing infrastructure projects that take into account the potential for soil erosion, landslides, and other hazards associated with steep slopes.

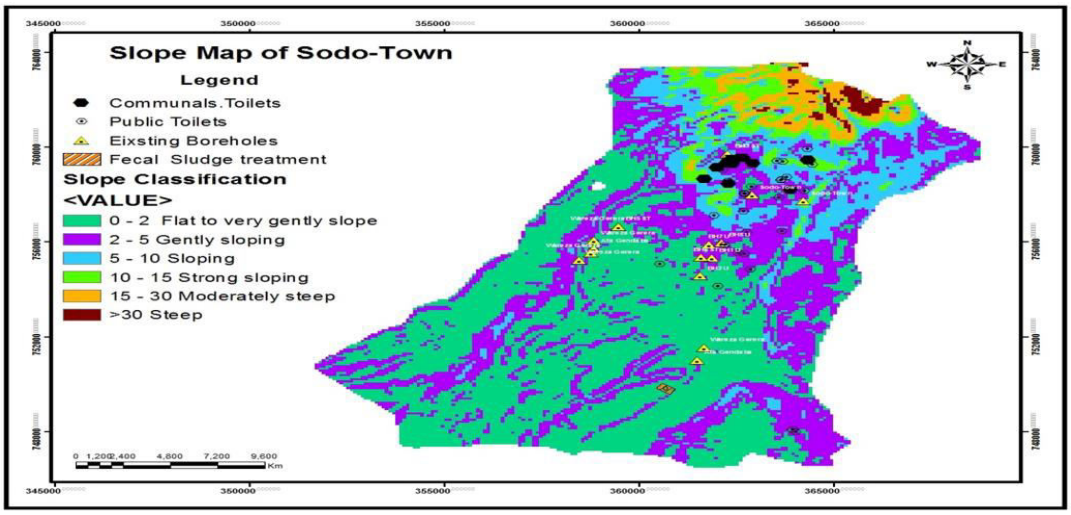

Figure 10 Slope map of WST

6.3.2 Soil Characteristics

Physical Characteristics: Soil physical properties play a critical role in the planning, design, and management of fecal sludge projects. Some of the relevant soil physical properties include texture, soil depth, color, and consistency. Understanding these properties can provide insight into how the soil will behave when subjected to different environmental conditions, such as the presence of waste materials, leachate, and gas generation.

Soil depth: Soil depth is the thickness of the soil layer that provides structural support, nutrients, and water for plants. Soil series that have bedrock between 30 and 50cm from the surface are described as shallow, while those with bedrock between 50 and 100cm are moderately deep. Soils with bedrock greater than 150cm are classified as very deep. In the treatment area under consideration, most of the soil falls under the very deep category, with a soil depth of 150-200 cm.

Soil color: it is one of the most noticeable features of soil and it is related to specific chemical, physical, and biological properties of the soil. In the proposed FSTP the soil color ranges from black cotton to grey on the top layer and yellowish in color at the bottom. The soil color can provide insight into the soil's composition and properties, such as the presence of organic matter, iron oxides, and other minerals.

Soil texture: is determined by the relative proportions of different particle sizes, particularly fine clay, and is an important factor in deciding the most suitable land use for a particular area. It has a direct impact on various soil properties such as infiltration, nutrient retention, drainage,

and erosion susceptibility. The texture of the soils in the proposed area varied from clay to clay texture in the top soils and the subsoil.

Figure 11 Soil profile of around FSTP WST

Soil Cover: The high content of montmorillonite clay in these soils can lead to some interesting soil characteristics, such as deep cracks during drier seasons. It's also interesting to note that vertisols typically form from highly basic rocks like basalt. This suggests that the parent material of the soil can have a big impact on its properties. The FSTP site is covered by Black cotton soil. In the case of a fecal sludge site, the porosity of the soil may be reduced due to compaction or other factors, leading to a lower infiltration rate. The blackish/ashy soil at the top may be a result of organic matter accumulation, while the yellowish clay soil could be a result of the high clay content in the vertisol. The presence of volcanic pyroclastic rocks at the bottom also suggests that there may have been volcanic activity in the area at some point in the past.

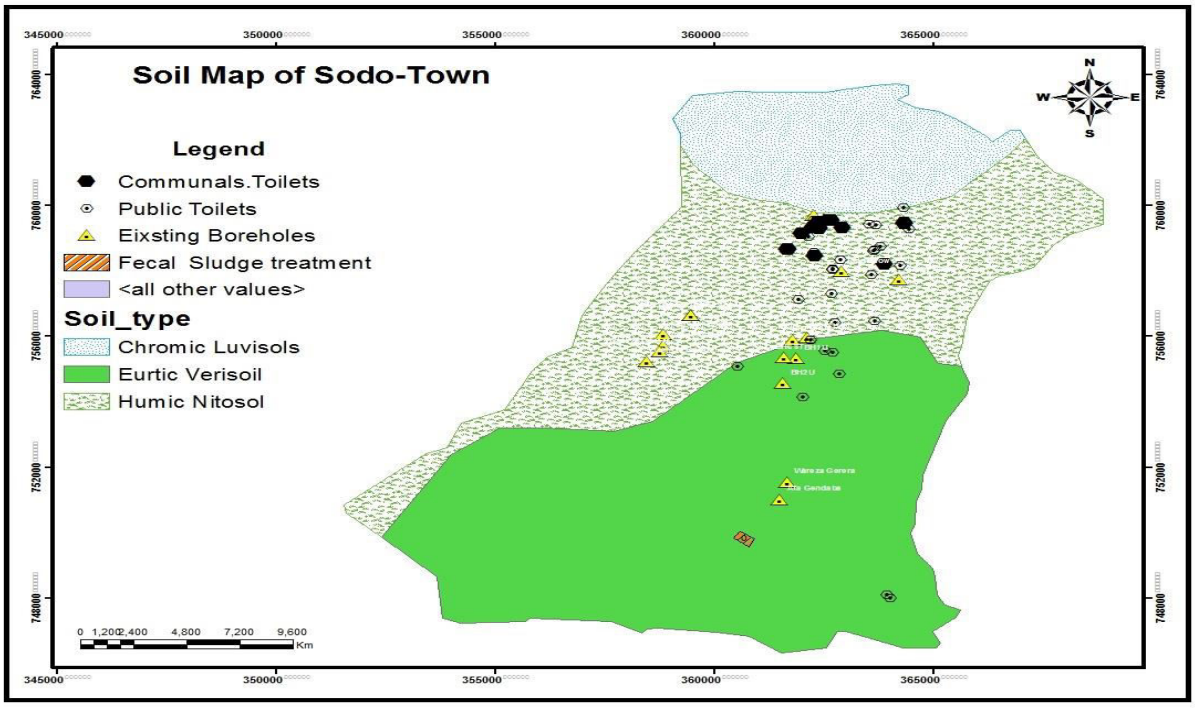

Figure 12 Soil map of WST

6.4 Hydro geological survey and investigation

6.4.1 Well Inventory

The water point inventory was designed to gather hydrogeological information directly from field sites, with a focus on wells deeper than 100 meters in the Sodo town area. The inventory utilized a sampling format that was outlined in the inception report, and data was collected from both the SNNPRS Region Water Bureau and through field surveys. The data collected included measurements of coordinates and elevation using GPS at each water point.

In particular, it seems that nine deep wells in Sodo town were drilled and constructed by the Ministry of Water and Energy in 2010, with six of them designated as production wells. However, only the deeper wells that met the criteria of being deeper than 100 meters were considered for data collection during the inventory. Any gaps in the data were filled in through field surveys conducted during the inventory process.

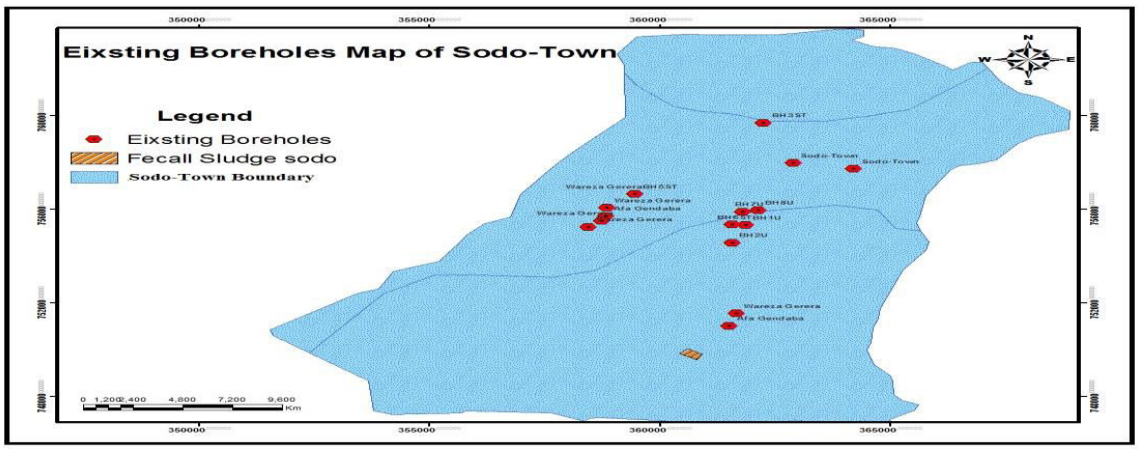

Figure 13 Existing water wells distribution point WST

6.4.2 Hydraulic parameters of aquifers

6.4.2.1 Static Water level depth

The static water level of the considered region differs, with specific values noted at different locations. According to previously gathered data, the static water level along the west side of Wareza Kebele measures 40.22m, 41.22m, and 37.24m. Additionally, towards the south of Sodo town, it records levels at 36.42m and 35.18m. Particularly to the west of Sodo town in the study area, the static water level resides below 27m. Towards the south of Sodo town, specifically in the upper catchment area, the static water level ranges between 35.18m and 36.42m. However, the study area for fecal sludge is located approximately 4.6km away from the upper well field area that houses two currently functional wells supplying water to Sodo-town.

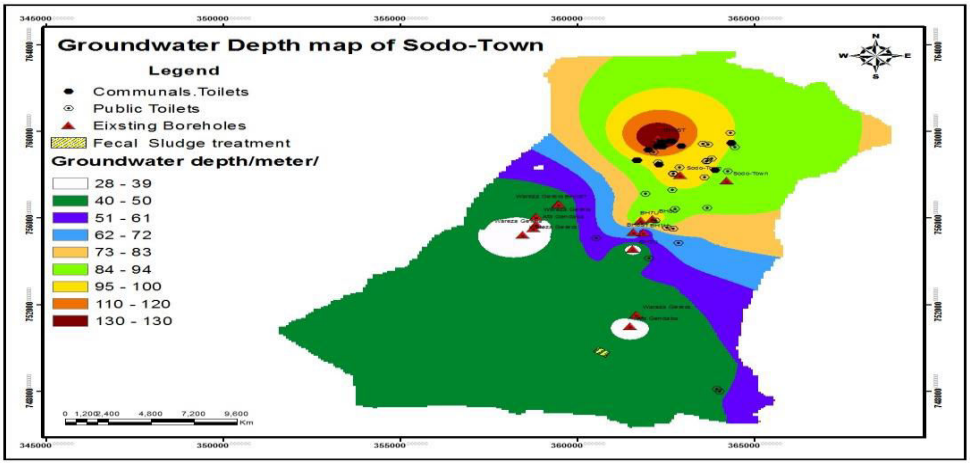

Figure 14 Groundwater Depth map WST

Transmissivity is a measure of the amount of water that can be transmitted horizontally through a unit width with in fully saturated thickness of the aquifer under a hydraulic gradient of one. It is the product of the hydraulic conductivity and the saturated thickness of the aquifer (Applied hydrogeology, C.W. Fetter):

T=bK Where T is transmissivity (m2/d)**,** b is the saturated thickness of the aquifer (m)**,** K is hydraulic conductivity (m/ d)**,** In the water point's inventory data, the transmissivity of boreholes more than six's existing data records. In the study area and its surroundings about 9 points were found of which only 6 points have transmissivity value the following deep wells more focus on the upper part of land fill site as below value.

1. **ANS-BH01**
   - ❖ Taking the aquifers thickness to be 52m, which takes the length of the total screen
   - ❖ The average transmissivity of the constant discharge test and recovery observation is 182.66m^2/day, and permeability can be calculated using the following formula:

$$K(m/day) = T(m^2/day)/b(m)$$

$$K(m/day) = 182.66(m^2/day)/52(m)$$

K= 3.51m/day

2. **ANS-BH02**
   - ❖ Taking the aquifers thickness to be 63.03m, which takes the length of the total screen
   - ❖ Average transmissivity of the constant discharge test and recovery observation 60m^2/day, permeability can be calculated using the following formula:

$$K(m/day) = T(m^2/day)/b(m)$$

$$K(m/day) = 60(m^2/day)/63.03(m)$$

K= 0.95m/day

3. Wazera Gerera Well

Method of Analysis	Transmissivity (m^2/min)	Storativity	Hydraulic Conductivity (m/min)
Time DDW method after cooper and Jacob	1.90×10^{-2}	2.84×10^{1}	4.76×10^{-4}
Distance-Time-Draw dawn Method after cooper and Jacob	1.90×10^{-2}	2.84×10^{1}	4.76×10^{-4}

6.4.2.2 Groundwater occurrence and aquifer system

The main aquifer in the Sodo town catchment area consists of significant geologic formations including Coarse sand pumice and fractured ignimbrite and Rhyolite tuff volcanic materials. These geological structures can enhance the porosity and hydraulic conductivity of the aquifer,

potentially leading to moderate to high transmissivity. The fact that the completion reports from previous drilling activities of 6 wells indicate that the aquifer layers exhibit high potential strengthens this statement. Transmissivity and the potential yield of an aquifer are highly dependent on both the physical properties of the rocks composing the aquifer (like porosity and permeability) as well as the fracturing and connectivity between these fractures: the geological formation in Sodo town.

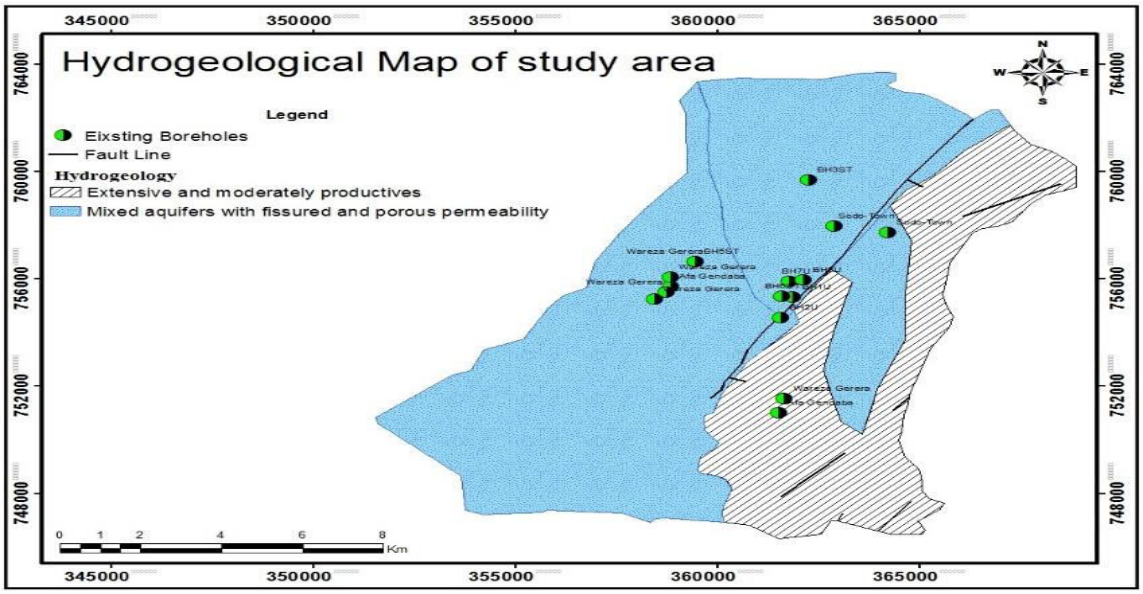

Figure 15 Hydrogeological Map of WST

6.4.2.3 Ground Water Flow and Recharge

6.4.2.3.1 Groundwater Flow

The direction of groundwater flow in the study area generally follows the high to low land areas at the surface, but subsurface flow is heavily influenced by geological structures in the area. The use of existing well data, including the static water level, can be used to determine the flow direction from one well to another. The surface flow in the study area starts from Damota Ridge, and all the rivers eventually collect and join Lake Abaya. Similarly, the subsurface flow is influenced by the hydraulic conductivity of the geological formations, such as the highly weathered and fractured pyroclastic volcanic rocks found along the bottom of the river. These formations have different structures and openings, as well as deposition of unconsolidated sediments that form secondary porosity, which creates favorable conditions for the movement and storage of groundwater along the structures.

6.4.2.3.2 Groundwater Recharge

Amesa Humbo of our study area Basin and Groundwater recharge is the study area local ridge of fractured, joint fault structures, stability of slope one mechanism recharging system groundwater. Our landfill site landscape is almost flat area of 90% covered with very stick clay soil, recharging starting northing-south sodo town local water divide line, the line two direction recharging west and east direction. A number of perennial and seasonal rivers and streams drains through the project communities as described in the existing water supply section which means not recharging directly but the eroded part of the site exposed in the middle of Abiya River highly weathered and fractured pyroclastic volcanic rocks which means a direct recharging system of drainage rout. The Abiya river small tributary is on the easting side Qaishe. R, Bordona. R and Dorzo. R drainage map of the study area as shown below.

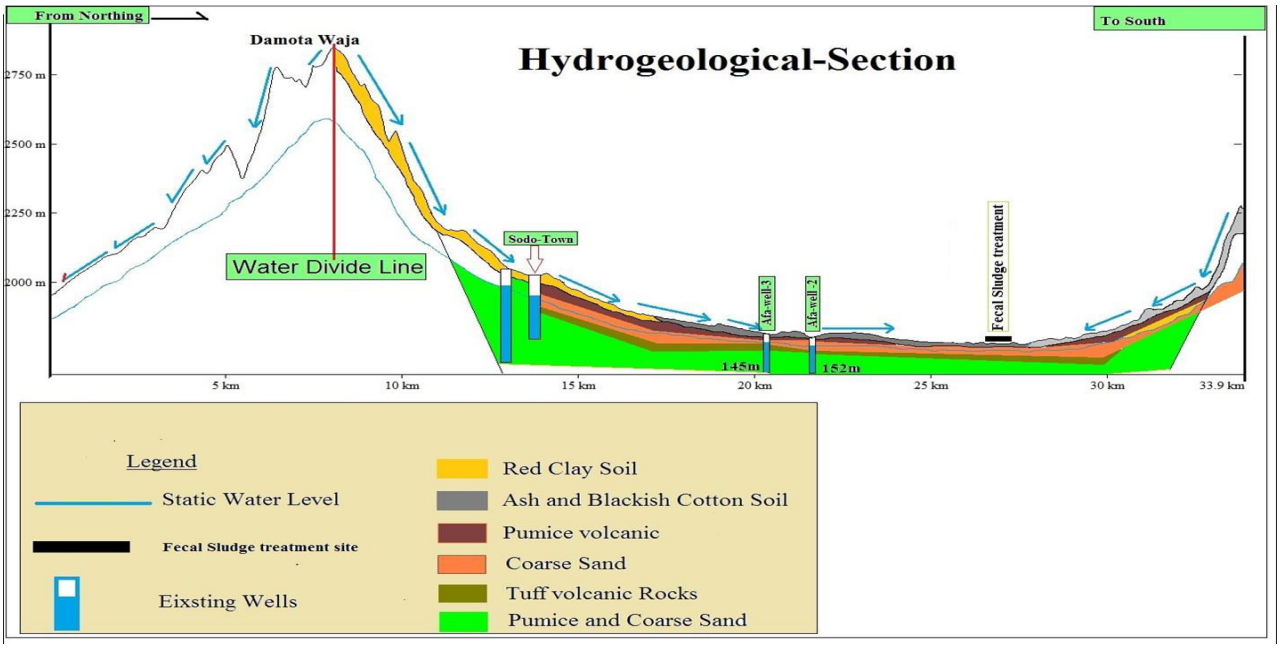

Figure 16 Groundwater flow cross-section

6.4.2.4 Water Quality

Water quality can be assessed based on the physical and chemical properties of the water, and the primary purpose of a water quality analysis is to determine the suitability of water for a proposed use, such as domestic (household), agricultural, or industrial use. Water samples were collected from the existing Sodo town two-boreholes previously physical-chemical analysis. The results of the analysis indicated that the measured physical and chemical parameters of the water fell within the acceptable limits of the WHO water quality standards Table 7.

Table 7 Water Quality Analysis Test Result

No	Parameters	ANS-BH-1	ANS-BH-2	Maximum allowable
1	**Physical Parameters**			
	Total Dissolved Solids, 1050C(mg/l)	132	130	1000
	Electrical Conductivity µs/cm) (EC)	202	198	-
	pH	6.45	6.47	6.5-8.5
2	**Chemical Parameters**			
	Ammonia (**mg/l NH_3**)	0.2	0.10	-
	Potassium (**mg/l K**)	9.6	9.40	-
	Magnesium (**mg/l Mg^{2-}**)	2.4	4.32	150
	Total Iron (**mg/l Fe**)	0.03	0.03	0.3
	Fluoride (**mg/l F^-**)	1.5	1.20	1.5
	Nitrite (**mg/l NO2**)	0.05	0.03	
	Nitrate (**mg/l NO3-**)	0.6	0.67	45
	Alkalinity (**mg/lCaCO3**)	104.5	106.4	-
	Sulphate (**mg/l SO42-**)	0.10	0.10	400
	Phosphate (**mg/l PO43-**)	0.39	0.31	-

6.5 Regional Geology

6.5.1 Precambrian Metamorphic and Intrusive Rocks

Biotite quartz oligoclase gneiss, medium grained amphibolites (Pfqg). The north-south trending shear zone crosses this lithological association. The dominant rock type is biotite-quartzoligoclase gneiss. The second most important rock type is fine to medium-grained amphibolites which occur mainly as bands. It is homogeneous, with rare, thin inter-beds of quartzite, amphibolites, and muscovite or biotitic bearing schist and gneisses.

Gneiss and granites undifferentiated (Phbg**)** are exposed near Lake Abaya in the southeastern part of NechSar national park along the Amaro horst of the map sheet. It follows the strike of the north-south trending fault.

Mafic and ultramafic rocks (Pumf) Mafic and ultramafic rocks are frequently weathered and/or altered to talc, chlorites, and epidote. Within the belt of mafic and ultramafic rocks, a granodiorite intrusion is exposed along the Wondena River. The rocks are sheared with quartz veins following the northeast-trending foliation. It also contains a lineation perpendicular to that of the northwest-trending foliation.

Mica schist and lesser chlorite schist (Psm) it is composed of muscovite and chlorites. These rocks are strongly weathered and highly friable.

Granite (Pgt) occurs mostly in the southeastern part of the map sheet. In horizontal sections, the granitic plugs have a circular to elliptical shape. Intrusive contacts with country rocks are sharp and homogeneous. This rock type is hard, compact, coarse-grained ,and generally pink.

6.5.2 Tertiary Volcanic Rocks

Lower basalt, rhyolite and trachyte (TV1). The Lower basalt is characterized by thick, extensive lava flows that locally show columnar jointing and intense weathering. This unit also comprises minor bodies of rhyolite, ignimbrite, and basalt.

Transitional mildly alkaline and sub-alkaline basalt and rhyolite are undifferentiated (Try) the transitional, mildly alkaline, and sub-alkaline basalts are usually strongly weathered, namely along fractures and joints. Where exposed, basalts tend to create cliffs. Transitional basalts are overlain by rhyolites. Locally, this unit comprises minor ignimbrite and trachyte bodies, generally with an aerial extent too small to be mapped at actual scale.

Aphyric and porphyritic basalt with lesser vesicular basalt, minor alkali trachyte flows and Tuffs (TV2). The subordinate vesicular basalt is brown colored, medium to highly weathered, and forms cliffs. Porphyritic basalts and aphyric basalts are exposed in the southern part of the area. In some parts of this unit, there is scarcelyexposed trachyte but it is not possible to map at this scale. In the southern part of the unit, the porphyritic basalt is intercalated with the aphyric basalt, especially along the road linking the small city s of Bule and Hacha.

Alkali trachyte flows with some plugs minor alkali trachytic tuffs and basalt (Ttr**).** the basalt which occurs in this unit is highly weathered, brown colored, and forms ridges. The tuffs are mostly composed of trachyte fragments and are not compacted as well as the ignimbrites.

Nazret group formation undifferentiated (Tig1)

It contains various rocks such as ignimbrites, rhyolites, basalts, and tuffs. The fresh ignimbrites are of a light gray to gray color shifting to light brown due to weathering. Most of the ignimbrites contain rhyolitic and trachytic rock fragments with a fine and compacted ground mass. The ignimbrites frequently display columnar jointing. Some of the basalts are slightly weathered with a porphyritic texture and consist of olivine, pyroxene, and plagioclase. The aphyric basalts are dark gray in color slightly weathered and usually form small hills.

Alkaline and per-alkaline silicic rocks, rhyolite domes, and ignimbrites (Tig2). Ignimbrites are the dominant features and have coarser rock fragments with a fine ground mass. They have a gray color and are slightly weathered forming a small hill. Individual flow units have a thickness reaching 6 m.

Stratified silicic ignimbrites, unwelded tuffs, ash flows, rhyolites, and trachyte, trachytic Tuffs with minor basalts and alkali trachyte flow and sediments (TV3) occur in the eastern part of the map sheet. The tuffs are made of trachyte fragments and feldspars dominate among the

crystal fragments. These deposits cover basalts on the border of the map. The underlying basalts are light gray in color. The other exposure is located in a road cut in hill forming topography along the Addis Ababa – Dila main road. The dominant rock type is ignimbrite which shows medium to high weathering. It occurs on hill forming topography and has a light gray color with high friability.

Alkaline basalt, trachyte, and peralkaline rhyolitic ignimbrite (TV4) are exposed on the northeastern corner of the map sheet forming a small ridge, approximately 3 km long. They are found nearby the cities of DemaChelko and Morke. The dominant rock of the unit is basalt but there are some trachytes and rhyolitic ignimbrites present. Since these acidic rocks have a small areal coverage they could not be mapped individually.

6.5.3 Quaternary Volcanic Rocks

Coarse unwelded pumiceous pyroclastic, ignimbrites, and diatomite (Qdp, Qdi) of the Dinoformation. The pyroclasts consist of pumice fragments within a fine ground mass; they are light, highly friable and have a light gray to yellowish color. They have a fine-grained ground mass and are glassy welded. The pumice fragments are rounded and some quartz and opaque crystals are present as accessories.

Quaternary basalts and scoria cones (Qwbp) the basalt is dark gray in color whereas slightly differentiated trachy basalts are light gray Figure 17. The basalt is faulted by a system of graben parallel to the Bilate River. Numerous scoria cones rise above the basaltic lava plain.

Per alkaline silicics undifferentiated (Qws) light yellow in color when not showing weathering. They are coarse-grained and are composed of rhyolite and trachyte rock fragments. Some of these units have coarse quartz grains and most of them are slightly weathered.

Pumice and unwelded tuff (Qwpu). The non-welded pumice and tuff deposits were produced by voluminous rhyolitic eruptions of Late Pleistocene to Holocene central volcanoes.

Rhyolite lava (Qwa), the rhyolites tend to be moderately to intensively weathered. In the case of central volcanoes, like Mt. Damote, the thickness may reach up to 900 m. **Obsidian (Qwo)** the obsidians are rich in crystals, which are dominated by plagioclase with less abundant Fe-clino pyroxene and Fayalite.

6.5.4 Quaternary Sediments

Eluvium (Qe) consists of residual clayey to silty soils of significant thicknesses, which represent Products of in-situ intensive weathering of both volcanic and metamorphic rocks. **Alluvial deposits** (Qa) comprising gravels, sands, and silts form alluvial fans and are located where rivers enter Lake Abaya. The large delta of the Bilate River is located on the northern edge of Lake Baya and a large alluvial plain can be found on its western banks to the north of Arba Minch. Polygenetic infill: resedimented, pyroclastic, lacustrine sediments, clays diatomites (Ql) are

widespread over the rift floor. Polygenetic sediments are dominated by resedimented pyroclastic deposits, mostly resedimented pumice and tuffs. These sediments form the infill of tectonic depressions and former calderas. On the map sheet, this lithology surrounds the southern margin of Lake Awasa

6.5.5 Local Geology

The local geology of the study area consists of volcanic rocks that are covered by black cotton soil and red clay soil, with the Abiya River nearby. The geological formation covering the study area is ignimbrite volcanic rocks, which are exposed in the middle of the Dry River, and the bedrock is composed of fractured ignimbrite rocks. These rocks have high infiltration rates, which can allow surface water to move into the groundwater. The direction of the geological structures in the fecal sludge site is north-south, with a geological fault line present on the western side and one on the eastern side. Understanding the local geology is crucial for fecal sludge projects as it can influence the groundwater flow and affect the stability of the fecal sludge.

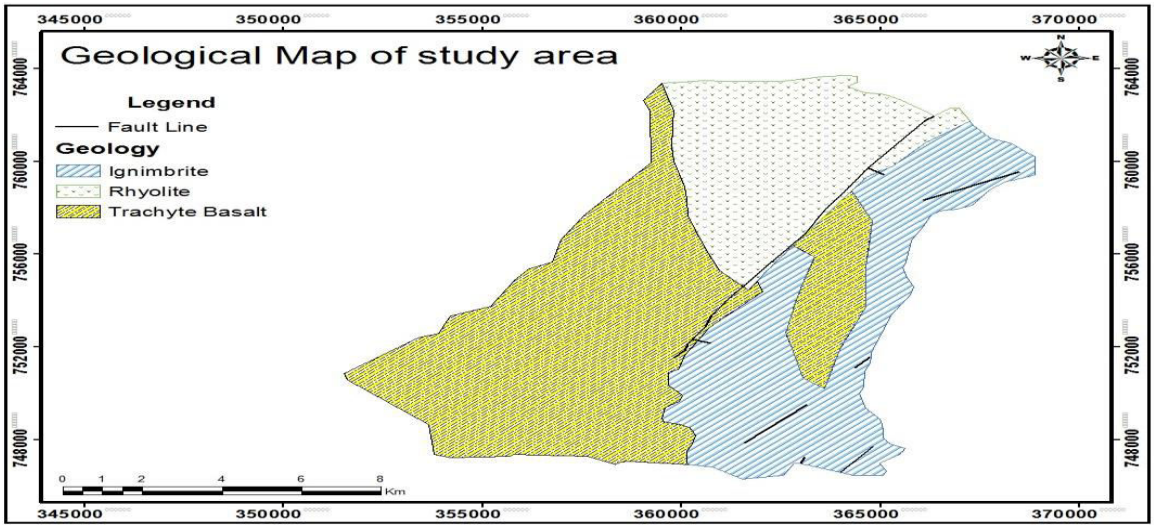

Figure 17 Geological Map of WST

6.5.6 Geological Structures of the Study Area

The fault lines in the Sodo town area. It's important to note that the presence and orientation of fault lines can have a significant impact on the stability of fecal sludge and other infrastructure projects. In this case, the Wareza fault line is located relatively close to the fecal sludge site, just 4.4km away. Additionally, the presence of two local faults with distances of 3.14km and 3km to the fecal sludge site further highlights the need to carefully consider the potential impact of fault lines on the stability of the Fecal sludge. It's also worth noting that the

fact that all fault lines in the area have an orientation of north-south direction could potentially indicate a larger tectonic feature in the area.

6.6 Biodiversity of the project Area

6.6.1 Flora and Fauna

Information on the forest category, vegetation types, species of flora and fauna, and current use of vegetation and plants were collected. Transect walks were performed to observe wildlife status in the study area. Group meetings were conducted with local people.

The proposed FSTP is found about 10km southwest of Sodo town state plantation forest in the specific area called **"Pundunia Meda"** with a limited variety of flora species types identified and described. The treatment main area has the dominant eucalyptus tree species (98%) and trees, shrubs, and herbs invasive species were distinguished.

Table 8 List of species identified flora of the project site

No.	**List of plant Species Identified in the study site**				
	Scientific Name	Family	Amharic Name	Local Name	Habit
1.	*Eucalyptus globulus*	Myrtaceae	Nech Bahirzaf	Botha barzaafe	Tree
2.	*Eucalyptus camaldulensis Dehnh*	Myrtaceae	Qey Bahirzaf	Zo7o barzaafe	Tree
3.	*Dodonaea angustifolia L.*	Sapindaceae	Kitkitta	Sankara	Tree
4.	*Croton macrostachyus Del.*	Euphorbiaceae	Bisaana	Ankka	Tree
5.	*Juniperus procera*	Cupressaceae	Yeabesha Tsid	Tsidda/Soqalla	Tree
6.	*Pterolobium stellatum*	Fabaceae	Konttir	Gom7ore	Tree
7.	*Jasminum grandiflorum L.*	Oleaceae	Tembbelell	Tsimbballo	Shrubs
8.	*Carissa edulis (Forssk.)*	Apocynaceae	Agam	Laade	Tree
9.	*Ximenia americana L*	Olacaceae	Enkkoy	Hastte	Tree
10.	*Grevillea robusta R. Br.*	Proteaceae	Graville	Graville	Tree
11.	*Prosopis0 juliflora (sw.) DC.*	Fabaceae	Zaf Weynie	Yewoyane Zaf	Tree
12.	*Blepharis edulis (Forssk.)*	Acanthaceae	Yayit Eshoh	Ebaabbo	Tree
13.	*Parthenium hysterophorus L.*	Asteraceae	Akenchira/Mete Arem	Ooratha harme	Herbs
14.	*Lantana camara*	Verbenaceae	Yewof Qolo	Holle gembbo	Herbs

(Source: Field expert's survey and observation findings, June 2023)

6.7 Social Amenities

6.7.1 Source of domestic water supply

The main source of potable water supply in WST is from groundwater (80%) while 20% from springs (20%). According to the WST water supply sector report, the monthly water demand for domestic usage is about 100,000 m^3 while public institutions demand is about 10,000 m^3. Thus, the city's monthly average water demand was 210,010m^3**.** However, regarding the monthly safe water supply of the entire town domestic 87,108 m^3, public 5,971 m^3commercial 29, 154 m^3, and all monthly safe water supply 123,653 m^3**.**

WSC water supply coverage reached 70% for domestic, 5% for public, and 24% for commercial or industrial demand. Considering water loss, from the extracted/produced water about 35% was lost in the usual domestic (5%), public (10%), garage (5%), urban agriculture (10%), and greenery (5%).

6.7.2 Energy and Power Supply

Kerosene, butane gas, and hydropower are the main sources of commercial energy in WST. In the domestic sector, about 90% of the population burns traditional solid fuels like firewood and charcoal. Low water levels in the hydroelectric dams cause frequent power cuts because the region still relies on the National Grid for its electricity source. Electricity lines cross through urban, small, and rural communities that are all connected. Even though many cities are close to an energy line, the level of access to power is low because of poverty.

6.7.3 Waste Management

In urban areas like WST with a high rate of urbanization and rapid population increase, wastewater management is a severe problem. There is no centralized or semi-centralized sewer network built for sewage in WST. The community is entirely dependent on on-site sanitation. This indicates that septic tanks and pit latrines are used to collect all of the fecal sludge.

The WST Water Supply and Sewerage Services Enterprise (WSTWSSE) is in charge of managing fecal sludge and wastewater in Wolaita Sodo. Therefore, WSTWSSE is in charge of emptying septic tanks and pit latrines with one vacuum truck, Wolaita Sodo University has its own vacuum truck.

The majority of residences in Wolaita Sodo (35%) dispose of their solid waste by burning it inside or outside their compound, 19% store it at home, and the other 19% collect it from a business or community, according to the results of secondaryy data analysis. Solid waste is transported and disposed of at an open site 7 kilometers outside of the city center. The Wolaita Sodo Municipality Sanitation and Greenery Office is responsible for managing the site in an

official capital city. However, there is no waste management present on the property, and leachate is not dealt with. It is anticipated that Wolaita Sodo produces about 64,000 m^3 (19,980 tons) of solid waste annually. In Wolaita Sodo, households account for the majority (66%) of the solid waste, with municipal waste (9%), followed by commercial entities (marketplaces, stores, garages, etc.) (13%), and then hotels, restaurants, cafes, and bars (8%). Less than 5% of the volume of solid waste produced is contributed by institutions, enterprises, and agriculture.

6.7.4 Road Network

Road networks play a great role in human movement which is directly associated with economic activities. To increase the road network, the City administration has been intensively constructing different types of infrastructure in the city such as roads, drainage, bridges, culverts, water supply, and electric light installation. As it is depicted in the Sodo municipality's 2015 E.C. Capital Investment Plan document, different types of roads constructed so far are asphalt roads 57.05km, cobble stone 107.77Km, gravel roads 12.67Km, compacted earth 180.27km and red ash 4.3km were constructed since the last 10 years. These road networks, besides smoothing interconnection with in the city, have their own contribution in connecting different Woredas in the Wolaitta Zone and other Zones surrounding the Zone.

6.7.5 Drainage Network

Proper constructed and maintenance of the constructed drainage is vital for community health, safety, and sustainability of the infrastructure. Since the introduction of World Bank-funded loans to City that invests in infrastructure improvement, the city's infrastructure especially road and drainage network coverage has dramatically increased. The city has constructed about 96,808.64 meter drainage canals of different types: masonry, concrete, and pipe drainages within the city.

Table 9 Drainage infrastructure network constructed in the WST.

S/N	Asset Category	Types	Unit	Total
1	Drainage Network	Masonry drainage	M	76,327.75
2		Concrete drainage	M	20,403.8
3		Pipe drain	M	77.09
4		**Total**	**M**	**96,808.64**

Source: Sodo municipality 2015 E.C. Capital Investment Plan document

6.8 Socio-Economic Baseline Information of the WSC

6.8.1 Demographic Characteristics

An exact figure for the population census of the city is currently ambiguous; due to the in-migration of people from other regions followed by unrest occurring since the last five years and the inclusion of rural Kebeles in the city. According to CSA projection the city population in 2020 is 264,210. Based on this census, the current population of the town is over 321472.8 with an annual growth rate of 5.7%, which is greater than the regional average urban population growth rate of 5.13% and the country-wise City population growth rate of 5.2%...

Regarding demographic characteristics of the population, the trend shows that the male population is slightly lower in aggregated amounts in the study area, while the female population is slightly higher through time regardless of the result stated in its feasibility study. This may be due to the inclusion of rural Kebele with a higher number of female population. For example: In 2011 E.C. for those Kebele included to urban, the male population was 43897.6 and the female counterpart was 44,929.8 which shows the female population is greater than male counterparts.

Regarding the age structure of the population, the area has a favorable age composition as shown in the figure below (almost 2/3 of the population are at employment age, i.e. 15-64), while the elder population (65+) amounts only to 1.6%. Also, the young population age group (0-14) represents approx. 33% demonstrating a low dependency ratio that equals 51% (Wolaita Sodo City structural plan, SNNP Regional State Urban Development &housing Bureau, Urban Plan Institute, 2017), while the economically active population corresponds to 65% of the total population. The 2020 urban population corresponded to 70.5% (186,138 inhabitants) and the rural population to 29.5% (78,072 inhabitants) and in the table below is provided the population as it is distributed per kebele in the study area.

Table 10 Distribution of Population in WST urban and rural kebeles

Study area	2007	2020
	Total	Total
Sodo Town (urban area)	76,050	186,138
Sodo Zurial Woreda /"rural" kebeles		
Ofa Sere (rural kebele)	6,246	7,851
Ofa Gandaba (rural kebele)	5,599	7,038
Kokotemarachare (rural kebele)	5,802	7,293
Humbo Larena (rural kebele)	2,758	3,467
Gututo Larena (rural kebele)	3,305	4,154
Wareza Gerera (rural kebele)	6,045	7,599
Mentegerera (rural kebele)	7,059	8,873
Tomegerera (rural kebele)	6,860	8,623
Wareza Shoho (rural kebele)	3,385	4,255
Waja Kero (rural kebele)	5,016	6,305
Damot Waja (rural kebele)	5,572	7,004
Bosa Kocha (rural kebele)	4,463	5,610
Sub-total ("rural" kebeles)	*62,110*	*78,072*
Total	138,160	264,210

Sources: CSA, National Population and Housing Census May-November 2007, 2020, CSA estimate and Consultant's processing)

6.8.2 Education Facility

According to data obtained from the city education office, the total number of educational institutions both public and private is about 156. Of which 63 are public and 93 are private schools. When this figure disaggregated into each level, there are 74 kindergartens (28 public and 46 private), 16 grade 1-4 (1 public and 15 private), 53 grade 5-8 (27 public and 26 private) and 13 schools are grade 9-12 (7 public and 6 private) schools.

As far as the total number of students in both public and private institutions in the current year 2015 E.C. is concerned, there are 72,595 students enrolled and studying. When this figure was disaggregated into their level of study, about 14,535 KG, 22,357 Grade 1-4, 18,671 grade 5-8 and 17,052 were in grades 9-12 as shown in the following graph. When number of students currently existing in private and government institutions compared with students enrolled in the same institutions in the 2007/8 academic year shows that there is a dramatic increment in students' enrolment. For example the total number of students in this 2015 E.C. academic year was 72,595 whereas the total number of students in 2007/8 was 30,418 which is a 138% increment within 7 years period. So, improved sanitary system development should consider the future potentiality of the City's different sectors' beneficiary increment.

Regarding the latrine status in each school, the City's education sector's report witness that each school has its latrine pit in its respective compound constructed from the existing local material mainly without compromising its quality. Construction and installation of septic tank in these school compound rarely exist which show sanitation system in schools are not sufficiently addressed. This may be due to the availability of school land to construct an optional latrine

when the previous one is ruined.

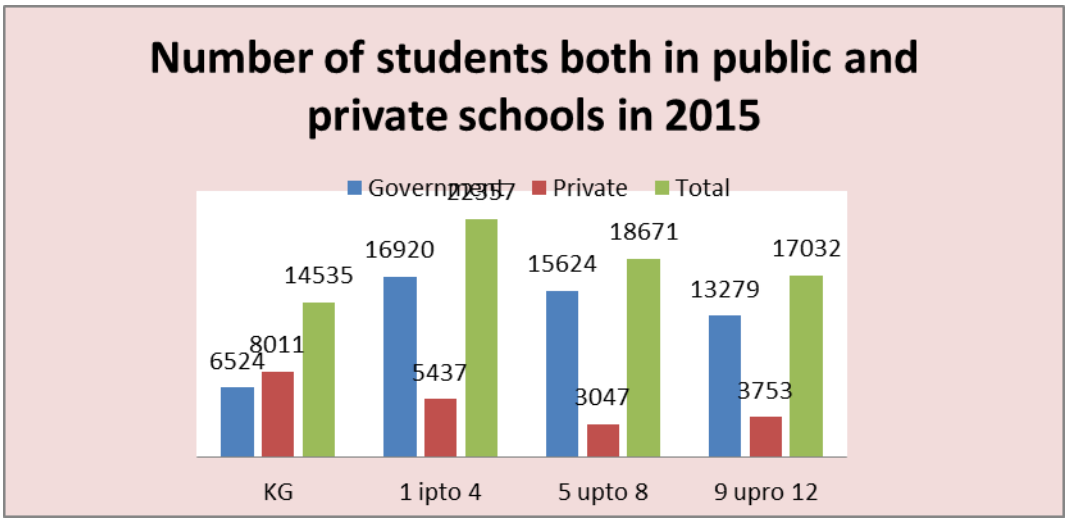

Figure 18 Number of students both in public and private entities in 2015 E.C.

6.8.3 Health

In the city, different types of health institutions are owned by the government and private individuals serving the residents of the city, communities around the city and other Woreda, and even patients from other zones and regions. According to the information obtained from the city health office, there are about 5 Hospitals (one government-owned and four privately-owned), three health stations (all government-owned), and 30 privately-owned clinics.

Meanwhile, the health professionals committed to delivering their professional ethics are about 283. When they were categorized into professional level, 114 (27 male and 87 female) were Diploma graduates, 155 (120 female and 35 male) were Degree graduates, 12 (10 male and 2 female) were MSC graduates and 1 male and 1 female were serving at specialists level.

As far as the toilet and septic tank coverage concerned, the primary data collected from the office witnesses that all health clinic, health station and hospitals were with required toilet and septic tank to be used by patient and staffs.

Regarding the health situation, the ten most prevalent diseases have been collected from health station of the city was investigated and found that all the most prevalent disease recorded were communicable disease associated with sanitation and hygiene problem and waste water. In more densely populated area, those diseases with communicability nature may have high prevalent rate so that with in short time period it can reach unprecedented number of people. It was also seen that the health station does not keep separate records of city patients from the rural surrounding communities that came to the city for medical treatment which may bias the decision making process associated with disease control.

Among those diseases, some were caused by intestinal parasite which is believed to have a due interrelation with lack of safe water supply and the degree of exposure to unprotected water sources. Communicable diseases pose a significant public health threat to the local communities. Health hazards typically associated with large development projects are those relating to poor sanitation and living conditions, sexual transmission and vector-borne infections. So the improvement of whole sanitary system and construction of waste water treatment plant is top priority

Data for most prevalent diseases for children under five recorded in 2012 E.C. was also taken and found that all ten top disease were communicable. About 10092 (4641 male and 5249 female) cases recorded in one year in which female children cases was slightly higher than male counter parts as depicted in the following Table 11.

Table 11 Ten Top Diseases recorded in 2012 E.C. in WST

Type of diseases	Nature	No. of Cases		Total
		Male	Female	
AURTI	Communicable	3367	3058	6425
AFI	Communicable	2676	2740	5416
Typhoid fever	Communicable	2100	2522	4622
Diarrhea	Communicable	2075	1734	3809
Dyspepsia	Communicable	902	1255	2157
Helmnthiasis	Communicable	963	854	1817
Pneumonia	Communicable	942	780	1722
UTI	Communicable	575	1052	1627
Trauma	Communicable	871	510	1381
Skin infection	Communicable	301	309	610
Total		14772	14814	29586

6.8.4 Tourism

As the WST is one of life long town in southern corridor and served as administrative and political center for one of historical nation in Ethiopia, it is endowed with different historical, cultural and archeological annotations which witness the wisdom of the nation and their social cohesiveness. Some of these sites to mention are:-

Borago Cave:-This cave is found in North West of Sodo city at the foot of mount Damata around Sodo Areka route. Some literature witness the name the city Sodo is derived from this cave as BORAGO CAVE means in Wolaitigna ‘Borago Sodo’ as people locally call it.

BITA BATA':- It is a pot like structure existing still today in Sodo city Geneme area; north west of City. This pot like structure was constructed as underground storage during the conquest of Italian forces may be to protect their materials from external enemies (Italian aggressor). As the name indicates 'BITA BATA' is driven from the cultural store formed from clay ('Bita' in Wolaittigna means clay and 'BATA' means store) constructed in the form of buried pot by laying its mouth upward. This underground constructed structure pinpoints; the creativity and wisdom of the people how they withstand the situation they face under harsh condition in early time.

Zebdiwos Chama Youth Center: One of historical site in Sodo city lied on more than 1000hectare of land at the back of current Sodo City administration office. The site was known to be built during the era of Emperor Haileselassie. Currently, the site is serving as youth recreational center holding public library.

Wolaitta Sodo University Culture Center: By initiative of Wolaitta Sodo University, Wolaitta cultural house was constructed within university compound in 2013 E.C. Though the house is constructed from durable modern construction materials, it maintained its size and shape to cope up with the cultural Wolaitta houses setting. Then the house was equipped with different materials used its people from ancient time to current time. These equipment are mainly used by its people for farming, marriage, funeral ceremonies, household utensils, warrior equipment and closes wore by the people for different occasions.

Currently, the center is opened for exhibition and being visiting University students and other people. As information gathered from University cultural center, more than 34,000 people visited the site.

6.8.5 Revenue Generation

Operating revenue includes any money the system receives for its services, including income from rates, tap/connection fees, penalties, and other sources. Operating expenses include items such as salary, benefits and employee taxes for staff, supplies, treatment chemicals, filters, utilities, insurance, lab and testing fees, minor repairs and regular maintenance system. Based on 2012 EC (2019-2020 G.C) annual report the revenue generated by the sale of goods or services is 57,891,077.40 and the total expense is 31,019,687.73, the gross profit is 26,871,390 ETB which shows that there is profit. And looking at the 2013 (2020-2021) annual report, both the revenues and expenses are greater than that of the 2012 EC (2019-2020 G.C), so the utility is progressive in financial capability.

7. Analysis of project alternatives

7.1 Do-Nothing Option/ Without Project Alterative

The No-Nothing CWIS Alternative neglects the construction and operation of public toilets, communal toilets, and FSTPs in favor of maintaining the unsanitary conditions brought on by the spread of raw, untreated excrement on the grounds surrounding Wolaita Sodo. The do-nothing option would also entail that human waste could contaminate the environment and local ground and spring drinking water sources without thorough fecal sludge management, which raises the danger of epidemics in already susceptible populations. It caused fatal illnesses like cholera and dysentery, which can quickly spread dangerously among the poor and truly impoverished in slum settlements.

In order to achieve the SDG targets and offer a citywide and more comprehensive sanitation approach is needed to address all urban zones. The no-project scenario cannot be a technically sound alternative because it would decline the town's sanitary services, which are crucial to boosting environmental problems and promoting unhealthy and non-productive residents.

7.2 Alternative Site For Proposed FSTP

The FSTP location was chosen by using the many specified criteria, which took a variety of choices into consideration. Wolaita Sodo FSTP development was suggested for two distinct alternatives. The optimal location was chosen after a comparison of the offered sites using fundamental environmental, social, and economic viability indices.

Alternative site 1: This alternative site is found in the southeast of the Woaita Sodo town. This project site is found within an area that is demarcated as an industrial zone forest area which is morethan 500m far away from the nearest industry or residential houses . Relatively this project alternative site do not have significant environmental health and social concern(Table 12). The land is government-owned and secured around 11 hectares. The area is large and can accommodate both short- and long-term horizons. Moreover, there are no local historical, religious, or archaeological resources that may make the site an appropriate candidate for FSTP in terms of social viability indices. The town master plan indicates that in this particular site, other developments like solid waste and waste water treatment plants are planned to be constructed in the near future. The site is acceptable from a technical standpoint because doing so could reduce the technical expertise, staffing requirements, and administrative expenses of operating two treatment facilities at different sites. Alternative site 1 is a good location for the FSTP in terms of odor pollution management due to the existence of long Eucalyptus trees that may be used as buffer zones or greenery belts. Moreover, in this location treated sludge and leachate can be utilized as soil fertilizer and cultivated plants due to the

availability of nearby farmland and gorges, and the site would have nearby safe disposal points for treated effluent water.

As a limitation, the proposed site is found nearby of Ethio- Kenya high voltage electric transmission line. Shifting the proposed site some 200m toward the West is a proposed and considered option for the ESIA team. This is because, of two reasons.The first one is developing a fecal sludge management facility near a high-voltage transmission line could potentially have impacts like safety concerns, Electromagnetic Interference. Fecal sludge management facilities when located near a high-voltage transmission line, there may be an increased risk of accidents or safety hazards due to the proximity to electrical infrastructure. Electromagnetic Interference: High-voltage transmission lines generate electromagnetic fields (EMF) around them. Certain equipment used in fecal sludge management facilities, such as electronic sensors or monitoring devices, may be sensitive to EMF. The close proximity to a transmission line could potentially result in electromagnetic interference, affecting the proper functioning of equipment or data collection. The Ethiopia-Kenya Electric Highway (Eastern Electricity Highway) is a 1,045 km length high-voltage transmission line (500 kilovolts, kV) which starts from the Wolayta-Sodo substation in Ethiopia to Suswa substation in Kenya.

The recommended setback distances for sensitive facilities near high-voltage transmission lines can vary depending on factors such as the voltage of the transmission line, the design of the infrastructure, and local regulations or guidelines. For instance, the International Commission on Non-Ionizing Radiation Protection (ICNIRP) suggests a minimum setback distance of 50 meters for 400 kV power lines, and a larger distance for higher voltage lines. In UK the National Planning Policy Framework (NPPF) suggests a minimum separation distance of 25 meters for 132 kV lines and 50 meters for 400 kV lines. In Australia, recommended setback distances of 30 meters for 132 kV lines and 80 meters for 330 kV lines. When we consider these guidelines as refrence for 500 kV transmission line the average setback distance can range from 62.5m (50 X 500/400) to 121m (80 X 500/330) 121m. Moreover, the project site is demarectated as industrial zone and the proposed project can generate subsential amount of odor during its operational phase, to minimize the possible odor problem buffer zones(wind breaks) that has been surrounded by trees are required. To minimize the possible risk from high volt electric lines and buffer zone for the project, the GSEMC team memebers decided asetback distance, some 200m away from the high voltage electric transmission line.

Unless mitigation measures are strictly followed the selected area will have some environmental and economic impacts. The area is known for its ground water potential (possible contamination), deforestation of *Eucalyptus* tree forest, and long-distance (10 km)

from the town center might result in high transportation expenses, especially for the fecal sludge.

Figure 19 Partial view of the FSTP alternative site one WST

Alternative site 2: The second alternative site is located at approximately 07°43'13.42"N and 38°37'42.55"E in the southwest direction of the city. It is located on the main Sodo-to-Arba Minch road, southwest of the city center. The site is about 5 kilometers from the main road, which needs construction of a new access road along the agricultural land. The proposed FSTP site is in a low-lying area of the city with high ground and subsurface potential.

The field trip revealed that the city's water supply is derived from shallow and medium-depth groundwater near the proposed FSTP site. The area is currently owned as agricultural land by youth unions and may require a resettlement action plan. Furthermore, there is a large amount of agricultural land and land that could be used for future urban development. Furthermore, a haul distance of 8.2 km from the waste production center and the requirement for a road to be built to access the site are limiting the site's suitability for FSTP. Another issue with the site is that it is mostly 5 kilometers from Sodo-Arba Minch's main road to the dumping sites and 15 kilometers from the city center). As a result, waste transportation by car may be difficult and inaccessible and uneconomical.

Figure 20 Partial view of FSTP alternative two EST

The optimal location was chosen after a comparison of the offered sites using fundamental environmental, social, and economic viability indices. Project site alternatives suitability were comparedto each other through various assigned criterion parameters with a score for each indicator parameter ranging from 1 to 5, where 1 is the worst(low) and 5 is the best(excellent). The technique used for the weighting of the criteria and indicators was rating. Scoring (weighting) of indicators was given based on legislative directions and best practices and was defined through expert judgment, stakeholders 'analysis, and knowledge considering the characteristics of the area. The score for each parameter was multiplied by the weighting factor. The scores and weights are summed to give a final score for the site.

From the assessment of environmental and social factors, the most suitable site against other sites with a site score of 95% is Site 1. In this particular location, the main Environmental issue is related to vegetation (deforestation) and possible ground water contamination which should be managed through due implementation Environmental management plan, country laws, RPF, and RAP guidelines. The summary of the assessment is provided in table (12) below.

Table 12 Parameters for Site Assessment, with their scoring method

	Criteria: indicators	*Score Criteria (1-5)*	*Weights*	*Alternative site 1*		*Alternative Site 2*	
1	**Biotic environment**			Score	Value	Score	Value
1.1	Biodiversity and habitats	1. Forests/significant wildlife reservoirs; 2. Areas without significant human presence; 3. Rural areas, have a fair amount of fauna species. 4. Wildlife species' presence is limited; 5.Locations with little or no ecological interest	6.25	3	18.75	2	12.5
1.2	Proximity to wetlands, protected, Sensitive Areas	1. Inside wetlands /protected area; 2. 0-99m; 3. 100-249m; 4. 250-500m; 5. ≥500m	11.25	5	56.25	5	56.25
2	**Natural environment**						
2.1	Topography of the site	1.Rough ≥3.5%; 2.Relatively rough 2.5-3.49%; 3.Relatively flat 1- 2.49%; 4.Almost flat 0-0.99%; 5.Flat 0%	13.5	4	54	4	54
2.2	Proximity to a river, stream lake	1. < 50m; 2. 50-99m; 3. 100-249m; 4. 250-500m; 5.>500m	5	5	25	4	20
2.3	Site outside a flooding zone	1. Frequently flooding Zone; 2. Occasionally flooding Zone 3. Rarely flooding zone; 4. Extremely rarely flooding zone 5.No flooding zone	5	3	15	3	15
2.4	Type of soil / Ground Water / Geotechnical stability of the site	1. Unsuitable; 2.Suitable requiring large-scale interventions 3. Suitable requiring medium-scale interventions 4. Suitable requiring small-scale interventions; 5.Suitable	3.5	2	7	2	7
2.5	Appropriate size	1. Not enough space; 2.Not enough space for FSTP and expansion; 3. Not enough space for all phases but potential expansion is possible ; 4. Enough space for the FSTP but any adjacent extension will be limited; 5. Enough space for the FSTP for the whole town and for future expansion	4.5	5	22.5	3	13.5
3	**Social environment**						

3.1	Proximity to residences, social structures	1.0-99m; 2. 100-199m; 3. 200-249m; 4. 250-499m; 5.≥500m	7.5	5	37.5	3	22.5
3.2	Proximity to Cultural heritage and religious sites	1.0-99m; 2. 100-199m; 3.200-249m; 4. 250-499m; 5.≥500m	3.75	5	18.75	5	18.75
3.3	Population Density,	1. Inside urban tissue; 2. Sparse suburban or village areas. 3. Areas with few residences, which can be resettled with the application of suitable measures; 4. Areas close to settlements or residences but without permanent residences within their boundaries; 5.Industrial areas or even uninhibited locations	10	5	50	3	30
3.4	Traffic and dust pollution,	1. Urban and industrial areas or locations with heavy transportation loads or intense manmade activities; 2.Areas with considerable transportation loads or manmade activities; 3.Areas with moderate transportation loads; 4. Natural areas, rural areas, or locations with low transportation and non-intense manmade activities; 5.Natural areas, rural areas, or locations with no transportation and non-intense manmade activities	3.75	5	18.75	4	15
3.5	Socio-economic factors	1. The area includes Important socioeconomic resource(s) (e.g. important touristic resource); 2.The area includes considerable socioeconomic resource(s) (e.g. commercial or productive); 3. The area includes moderate significance socioeconomic resource(s) (e.g. agricultural); 4. The area includes socioeconomic resource(s) of low significance (e.g. sheepfolds); 5. The area does not include socioeconomic resource(s)	5	4	20	3	15
3.6	Public opinion	1.Negative; 2.Mostly negative;3.Positive with significant reservations ; 4.Positive with reservations; 5.Positive	8.5	4	34	3	25.5
4	**Manmade environment**						
4.1	Existing Land use,	1. Urban/ important infrastructures (schools, hospitals etc.) or natural areas (e.g. forests); 2. Sparse residential uses or land uses with considerable importance (e.g. touristic attractions etc.)	6.25	4	25	3	18.75

		3. Land uses common in the wider area with moderate importance(e.g. rural areas); 4. Land uses with no significant importance (e.g. grassland, informal greenery); 5.Industrial areas or disrupted locations (e.g. inactive quarries or disposal sites)					
4.2	Accessibility of the site by an existing road	1 . No access road / Access Road doesn't reach the site; 2. Existing gravel access road in poor condition; 3.Existing gravel road in good condition; 4 . Existing asphalt road in poor condition; 5.Existing asphalt road in good condition	2.5	1	2.5	1	2.5
4.3	Accessibility and infrastructure availability (road, electric water)	1.≥500m; 2.250-499m ; 3.100-249m ; 4.50-99m; 5.0-49m	3.75	1	3.75	1	3.75
			100	57 (95%)	408.75	49 (81.7%)	330

7.3 Technology Alternatives

7.3.1 Selection of fecal sludge treatment technologies

The fecal sludge treatment technique typically consists of three stages: primary treatment, where the solid and liquid components of the waste are separated, sludge treatment, and liquid or leachate treatment, which is the last step of treatment and is produced by the first treatment. The primary and sludge treatment methods that are most suitable for WST were identified through a literature analysis, feasibility study, and detailed study report assessment. This section gives an overview of the possible treatment technology alternatives, including their fundamental principles, advantages, and disadvantages from the perspectives of the environment, social, and the economy Table 13.

7.3.1.1 Technology for Primary Treatment

Primary treatment is used for solid-liquid separation (dewatering) as well as for the treatment of solid and liquid parts of fecal sludge that is generated from the septic tank, pit latrine, and other onsite sanitation systems. The technologies used for primary treatment are: 1) Drying Bed (UDB), 2) Planted Drying Bed (PDB), and 3) Settling and Thickening (S&T) Tank.

Unplanted Drying Bed: this is a simple, permeable bed that has numerous drainage layers as demonstrated in Figure 21. When loaded with sludge, it collects leachate that has percolated through the bed and enables the sludge to dry by percolation and evaporation. Between 50 and 80 percent of the volume of the sludge flows out as liquid or evaporates. However the sludge has not truly stabilized or sanitized. Before the dried sludge may be properly disposed of or utilized as a nutrient-rich soil additive in agriculture, it may require further treatment by composting.

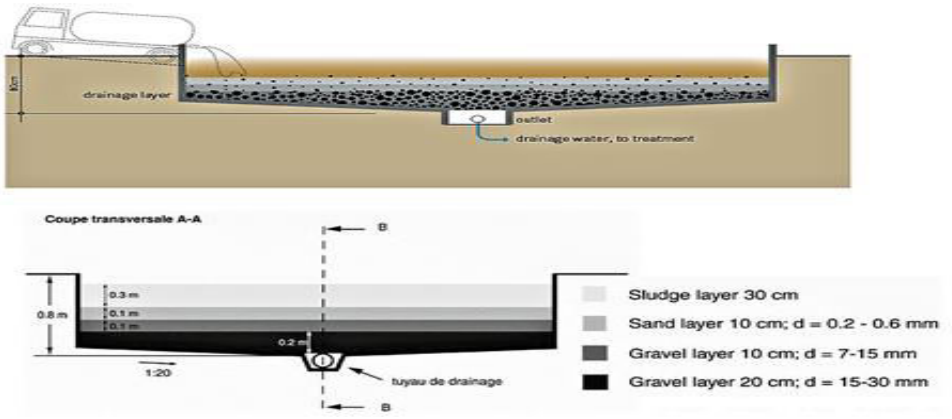

Figure 21 Schematic of an unplanted drying bed

The percolate has to be collected for treatment or regulated reuse since bacteria are still present. Before adding new sludge, unplanted drying beds must be de-sludged. Although frequent desludging necessitates huge surface areas, personnel, or mechanical power, drying beds are very simple to build and maintain Table 13.

Table 13 Comparative analysis of Primary Treatment technologies

Technology Alternatives	Advantages	Disadvantages
Unplanted Drying Bed	Relatively low capital costs; low operating costs	High land requirements
	Good dewatering efficiency, especially in dry and hot climate	Odors and flies are normally noticeable
	No energy requirements	Labor intensive removal
	Can be built and repaired with locally available materials	Limited stabilization and pathogen reduction
	Simple operation, only infrequent attention required	Leachate requires further treatment
	No experts, but a trained community required	Requires expert design and construction supervision
Planted Drying Bed (PDB)	Can handle high-loading	Requires a large land area
	Better sludge treatment than in unplanted drying beds	Odors and flies may be noticeable
	Easy to operate (no experts, but trained community required	Long storage times
	Can be built and repaired with locally available materials	Labor intensive removal
	Relatively low capital costs; low operating costs	Requires expert design and construction supervision
	No electrical energy required	Leachate requires further treatment
	Fruit or forage growing in the beds can generate income	Only applicable during dry seasons or needs a roof and contour bund
Settling and Thickening (S&T) Tank	Thickened sludge is easier to handle and less prone to splashing and spraying	Requires a large land area
	Can be built and repaired with locally available materials	Odors and flies are normally noticeable
	Relatively low capital costs; low operating costs	Long storage times
	No electrical energy is required	Requires front-end loader for desludging
		Requires expert design and construction supervision
		Effluent and sludge require further treatment

Planted Drying Bed (PDB): A planted drying bed is comparable to an unplanted drying bed as demonstrated in Figure 22, but the presence of plants adds the advantages of increased sludge treatment and transpiration. For the purpose of separating the solid from the liquid part of fecal sludge from latrines, septic tanks, biogas reactors, trickling filters, etc., it is a sealed shallow pond filled with various drainage layers. By using a mix of percolation and evaporation, sludge is naturally dried. The filters do not need to be desludged after each feeding/drying cycle, which is the main advantage of the planted bed over the unplanted bed.

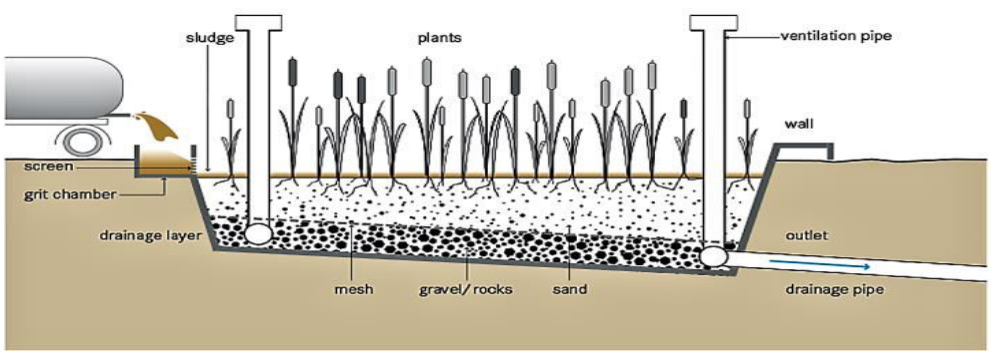

Figure 22 Schematic of a planted drying bed

The plants and their root systems maintain the porosity of the filter, allowing new sludge to be put directly over the preceding layer. Unlike unplanted drying beds, planted drying beds (also known as humification beds) only require desludging once every five to ten years. The removed sludge provides a nutrient-rich soil amendment that may be utilized right away in farming.

Settling and Thickening (S&T) Tank: Settling-cum the thickening tank (ST tank) primarily permits heavier septage particles to sink to the bottom of the tank due to gravity while lighter septage components (fats, oils, grease, and water) remain above. The supernatant is expelled from ST tanks by an outlet on the other side of the intake, which is rectangular in form. To stop the scouring of settled sludge and the separating of scum, a baffle can be put at the outflow. The tank primarily has two compartments, occasionally three compartments, which can be alternately utilized for loading septage as illustrated in Figure 23.

Figure 23 Schematic of a Thickening Pond

Each tank is loaded for a minimum of a week, after which the sludge is allowed to thicken and settle, stabilizing the settled solid through the anaerobic sludge digestion process. Then, at regular intervals, thickened sludge is injected into the sludge drying bed. If the sludge is not thick enough, it is often removed by vacuum truck, excavator, or pumping.

7.3.1.2 Decision matrix for primary treatment technology (solid-liquid separation)

The groundwater level, land need, energy requirement, skill required, capital cost (CAPEX), operational cost (OPEX), and sludge treatment technical possibilities were taken into consideration while creating the decision matrix for treatment technology. The selection of fecal sludge treatment technology for WST also depends on the UWSSP-II sanitation goals, the minimum/indicative wastewater quality standard values set out within the UWSSP II ESMF/WBG EHSG as well as benefits to the environment and health, and the elimination of open defecation. The decision matrix compares the benefits of various technologies based on factors related to the economy, the environment, and social safety. The UDB and PDB require a lot of area but no energy is needed. Whereas, the groundwater level should be deep for S&T tanks, although the UDB and PDB do not depend on it for operation Table 14.

Table 14 Main characteristics of the sludge dewatering process

CHARACTERISTICS	**UDB**	**PDB**	**S&T**
Land requirements	+++	+++	+
Energy requirements	-	-	+
CAPEX	+	+	+
OPEX	+	++	+
Groundwater level	+	+	++
Skill requirement	+	++	+
Discharge standard	++	++	++
Operational complexity	+	++	++
Maintenance requirements	+	++	++
Complexity of installation	+	++	++
Influence of climate	+++	+++	+
Sensitivity to the type of FS	+++	+++	+
Chemical product requirement	-	-	+
Dewatered sludge removal complexity	++	++	++
Level of dryness	+++	+++	+
Odors and vectors	+++	+++	
Noise and vibration	-	-	+
NB +: low favorability; ++: moderate favorability: +++: high favorability; -: no need			

The decision matrix compares the benefits of various technologies based on factors related to the economy, the environment, and social safety. The UDB and PDB require a lot of area but no UDP is determined to be the most appropriate option based on the decision matrix analysis for WST FSTP as liquid-solid separation. The PDB comes after it. Consequently, for WST FSTP, UDP,

the principal treatment (solid-liquid separation) technique, was selected. Evaluations conducted with drying beds have shown that they offer effective treatment, simple operation, and maintenance methods, resistance to shock loads, and climate adaption. Furthermore, sludge drying beds in general less sophisticated compared to other alternatives, more flexible, easier to operate, and use less energy during operation than mechanical systems, which would make them preferable dewatering options for WST.

7.3.2 Technology for sludge treatment and disposal

Sludge that has undergone partial treatment is produced after dewatering. This treated FS cannot be used directly in agriculture since it still contains pathogenic bacteria and parasite eggs. Further treatment is needed to raise the sludge's quality. This is the last step in the sludge treatment process before discharge. 1) Composting, and 2) solar drying are the methods employed for further sludge treatment.

Co-composting: Fecal sludge and municipal solid waste co-composting is a biological process that uses microorganisms to break down organic material in an aerobic environment as shown in Figure 24. The processing of source-separated human feces has made extensive use of this technique. Fecal sludge is dewatered, and the partially treated sludge is combined in a ratio of 1:2 or 1:3 with the organic portion of municipal solid waste. The survival of microorganisms throughout the composting process depends on properly regulated moisture and aeration conditions. Municipal solid waste has strong bulking qualities and is rich in organic content; whereas, feces have a high moisture and nutrition content.

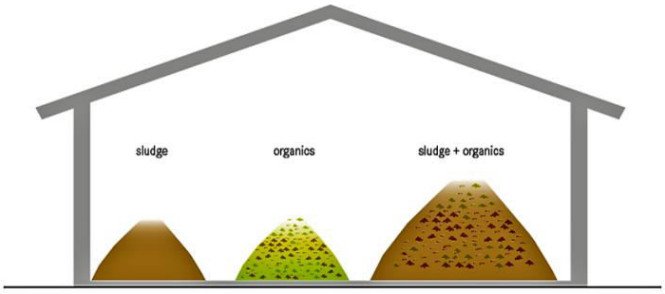

Figure 24 Schematic of the Co-compost

Stabilized organic matter that may be utilized as a soil conditioner is the final outcome of co-composting. Furthermore, it includes nutrients that can act as a long-term organic fertilizer and have positive impacts. A high temperature (50-70^{o}C) is maintained during co-composting for 3 weeks in order to destroy helminths eggs and harmful bacteria. The co-composting procedure takes 10–12 weeks. A comparative analysis of Co-composting is given in Table 15. Only when a

source of well-sorted biodegradable solid waste is available the co-composting technique be used.

Table 15 Comparative analysis of sludge treatment and disposal technologies

	Advantages	**Disadvantages**
Co-compost	Relatively straightforward to set up and maintain with appropriate training	Requires a large land area (that is well-located)
	Provides a valuable resource that can improve local agriculture and food production	Long storage times
	A high removal of helminths eggs is possible (< 1 viable egg/g TS)	Requires expert design and operation by skilled personnel
	Can be built and repaired with locally available materials	Labor intensive
	Low capital and operating costs	Compost is too bulky to be economically transported over long distances
	No electrical energy required	
Solar Drying	High efficiency for dewatering	Large space requirements
	Low energy requirements	Need mechanical means to turn sludge
	Low investment cost	Ventilate the greenhouses

Solar Drying: Treatment by solar drying is generally done in greenhouse structures with glassy covers, concrete basins, and walls. Sludge is disposed of into the concrete basin and processed for about 10–20 days. Options exist for batch or continuous operation, with devices to control the conditions in the greenhouse (e.g., ventilation, air mixing, temperature). The main factors influencing the evaporation efficiency in these systems are the solar variation, air temperature, and ventilation rate, with the initial dry solid content of the sludge and air mixing also influencing.

Figure 25 Schematic of solar drying

7.3.2.1 Decision matrix for sludge treatment technologies option

Based on the sludge treatment technical options, a decision matrix was prepared for WST with respect to land requirement, energy requirement, skill requirement, CAPEX, OPEX groundwater level, and discharge standard Table 16.

Table 16 Decision matrix for sludge treatment technology

Constraint	Co-composting	Solar drying
Land requirement	+++	+++
Energy requirement	+	+
Groundwater level	+	++
CAPEX	+++	++
OPEX	+++	++
Skill requirement	+	++
Discharge standard	+++	+++
NB +: low favorability; ++: moderate favorability: +++: high favorability; -: no need		

Based on the decision matrix (Table 16), solar drying treatment is the best alternative sludge treatment technique that ESIA teams could provide based on the real conditions in WST in terms of the selected solid-liquid separation treatment plant, current sanitation level, and climate consideration. Furthermore, co-composting was strongly advised for further treatment of dried sludge by an ESIA consultancy team as a secure solution for disposing of dried sludge. It is because keeping the dried sludge enclosed in the landfill for over a year causes the pathogens to perish and eliminates the moisture still present in the dried sludge. Co-composting also aids in the inactivation of pathogens and produces a product that is useful as a soil conditioner.

7.3.3 Technology for leachate /liquid effluent treatment

To meet the standards for water reuse or release into the environment, the liquid effluents from dewatering technology must first undergo further treatment. This liquid effluent frequently needs extra treatment to fulfill the criteria for discharge quality. Therefore, a low-cost technique should be used (e.g., wetlands, waste stabilization ponds).

Waste Stabilization Ponds (WSP): The cheap capital and operating and maintenance expenses of WSP make them a viable choice for wastewater treatment in underdeveloped nations. In general, they are made up of a number of ponds with different names depending on what they are used for facultative, maturation, or anaerobic ponds for lowering organic, nutrient, and pathogen loadings through sedimentation and biodegradation under anaerobic, anoxic, and/or aerobic conditions (Figure 26).

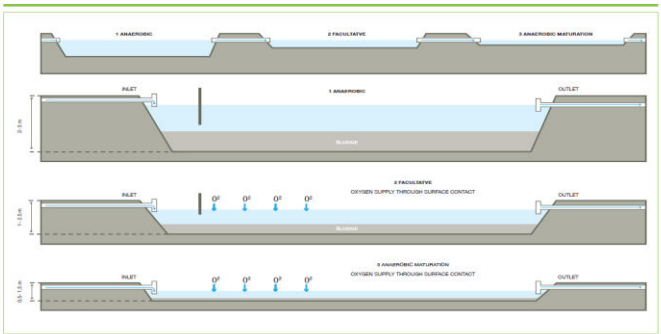

Figure 26 Typical scheme of a waste stabilization system

The ponds might be sealed with clay, asphalt, or any other impermeable material to stop water penetration. The properties of WSP will change depending on the scenario of liquid fecal sludge dewatering and thickening effluent. The effluent properties, which can be very diverse as indicated in Table 17, will dictate the number of ponds and the type of maintenance necessary.

Constructed Wetlands: In the treatment of wastewater, there are three types of constructed wetlands as illustrated in Figure 27. The treated water flows horizontally and above ground in free water surface wetlands (FWSW), whereas it flows horizontally and underground (5 to 15 cm below the surface) in subsurface flow wetlands (SSFW). A planted drying bed is what the vertical-flow constructed wetland (VFCW) does. Of course, the direction of the wastewater flow channel is a key distinction between VFCW and FWSW/SSFW wetlands.

In contrast to the other two systems, which constantly function under aerobic circumstances, this causes occasional aerobic-anaerobic situations in the VFCW. The horizontal-flow systems, on the other hand, are more susceptible to clogging, which may be brought on by a high SS content in the liquid to be treated. As a result, they should primarily be employed to remove dissolved pollutants, with the VFCW being more successful at doing so. To properly treat wastewater, a hybrid unit can mix FWSW, SSFW, and VFCW.

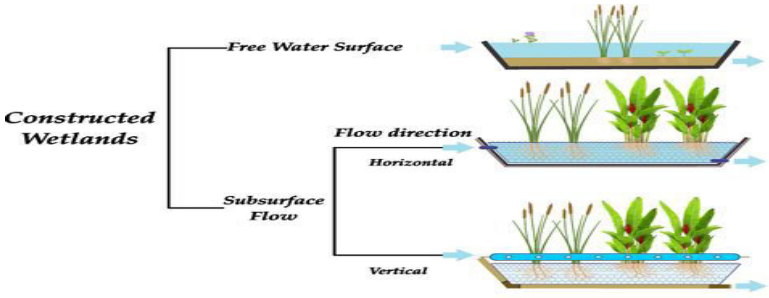

Figure 27 Scheme of types of constructed wetland

Table 17 Key features of treatment options for liquid effluents from dewatering units

	Key features	Advantages	Disadvantages
Waste Stabilization Ponds	Consists of bioreactors in series operating under anaerobic, facultative, and aerobic conditions	Low construction costs	Requires large land area
	BOD removal: 80-95%	Low O&M costs; main O&M requirement includes weeding (to prevent breeding of mosquitoes) and removal of scum	May promote the breeding of insects
	Residence time: 20-60 days	Low energy demand	The odor may be generated in some cases
		Appropriate for treating high-strength effluent	Well suited for tropical and subtropical countries
Wetlands	Organic loading rate: 30-110 g COD m^{-2} d^{-1} (typical: 75g BOD_5 m^{-2} d^{-1})	Does not require chemicals, energy, or high-tech infrastructure	Requires large land area
	Hydraulic residence time: typically 3-6 days	Suited for combination with aquaculture or sustainable agriculture (irrigation)	Delayed operational status (vegetation establishment needed for peak removal efficiency might take 2-3 years)
		Attractive landscape features, Good control of odor	Pretreatment of the effluent may be required to prevent clogging of the filter bed
		High reduction in BOD, SS and pathogens possible, Low construction, O&M costs	Not very tolerant of cold climates

An anaerobic baffled reactor (ABR): An anaerobic baffled reactor (ABR) is an enhanced septic tank with a series of baffles that compel grey, black, or industrial effluent to flow under and over the baffles from the entrance to the output. The treatment is improved as a result of the longer contact time with the active biomass (sludge). Although ABRs are strong and can handle a variety of wastewater types, further treatment is still required before residual sludge and effluents may be adequately recycled or released.

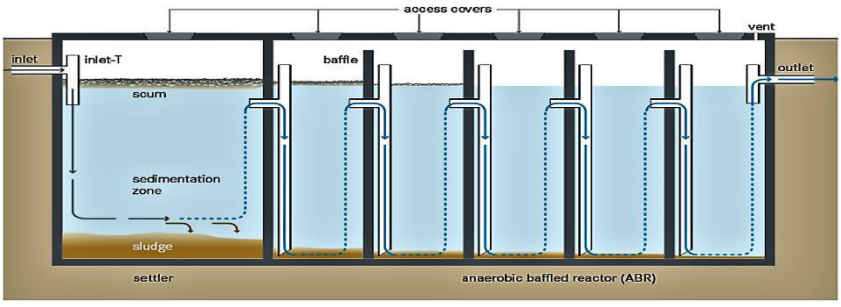

Figure 28 Schematic of the Anaerobic Baffled Reactor

Table 18 Comparative analysis of an anaerobic baffled reactor

Advantages	Disadvantages
Resistant to organic and hydraulic shock loads	Long start-up phase
No electrical energy is required	Requires expert design and construction
Low operating costs	Low reduction of pathogens and nutrients
Long service life	Effluent and sludge require further treatment and/or appropriate discharge
High reduction of BOD	Needs strategy for fecal sludge management (effluent quality rapidly deteriorates if sludge is not removed regularly)
Low sludge production; the sludge is stabilized and simple to operate	Needs water to flush
Moderate area requirement (can be built underground)	Clear design guidelines are not available yet

7.3.4 FSTP Technologies Adopted For Wolaita Sodo Town

Diverse combination methods were implemented worldwide for solid-liquid separation throughout the treatment process, and then wastewater underwent further treatment before being released into the environment. The decentralized wastewater treatment system (DEWATS) was the most widely used technology in developing countries.

In reality, WST lacks a facility for the treatment of fecal sludge or wastewater, thus vacuum trucks are used to transfer sludge to illegal dumps. In view of this, the various fecal sludge management options have been examined by – Roikos and ZA Engineering S.A and reported in the feasibility study and detailed design of CWIS for WST. Based on the outcome of several technology selection criteria analyses, the consultant has proposed their top choice for properly treating the produced fecal sludge for WST that comprises of Settling – thickening tanks, an unplanted sludge drying bed, and constructed wetlands with an anaerobic baffled reactor (ARB). The sequence of the proposed fecal sludge treatment process consisted of fecal sludge and septage receiving and screening unit- Settling – thickening tanks- Sludge drying beds- Flow equalization tank and pumping station- Anaerobic baffled reactor– Wetlands feeding pumping station- Constructed wetlands.

The ESIA consultancy team also recognized the suggested method for treating fecal sludge in WST by the design and feasibility study Consultancy Roikos and ZA Engineering S.A. There was a tripartite discussion between the ESIA consultant, design consultant and the client. The

objective of the discussion was to reach on agreement towards the proposed FSTP technological options. All of the participants agreed on the selected technological options for their feasibility and applicability towards treating fecal waste with minimum environmental and social impact. These technological possibilities offered the possibility of successfully treating fecal sludge to generate leachate effluent that could be safely disposed of without damaging the environment or providing health risks to people. Sludge and leachate that would fulfill the minimal or indicative wastewater quality standard values described in the UWSSP II, ESMF/WBG EHSG can also be treated using the suggested fecal sludge treatment approach.

8. Potential Sub-Project Impacts

Introduction

Diverse environmental and social implications will possiblyarise from Sustainable City-Wide Inclusive Sanitation Management project. Notably, some of the impacts are seen within the project locations and others along the routes leading to the project sites. The impact level of such sanitation-related projects on the environment depends on the nature of the receiving environment, access, affordability, quality, and quantity of sanitation infrastructures; the proportion of the population covered; and the utilization of the sanitation facilities by the population. The sensitivity of the receiving environment is determined by specialists' keen field observation and environmental baseline information analyses. In this chapter, prediction, and analysis of possible positive and negative impacts of the construction and operation of the sanitation project are presented.

8.1 Assessment Methodology

The impact assessment was done though a standardized structured impact assessment process. The identification of impacts was done first by collecting a comprehensive list of key potential environmental and social impacts related to the project.

Impact identification: Prediction of possible impact determined in line with what could potentially happen to resources and receptors as a consequence of the project and its associated activities. The sections of the environment considered include the physical environment (landscape, geology, soil, air, and water) biological environment (wildlife habitats, biodiversity), socioeconomic environment (economic systems, cultural heritage, settlement patterns, and employment levels). Moreover, the potential impacts and receptors were identified in accordance with the project stages like pre-construction, construction, and operational phases. The identification of sources of possible impacts was conducted by using checklists. This was followed by listing possible receptors of the impacts on the environment. The Possible impact receptors in the environment were identified by surveying the existing environmental and socioeconomic conditions through baseline studies and consultation with concerned parties.

Impact Description: An impact is both a description of the planned project activities and their effects on the environmental or social receptors. Impact description technically characterizes the causes and effects of impacts, and their secondary and synergistic consequences for the environment and the local community. Potential impacts of the proposed projects, their characteristics, and the attributes of the receiving environment were predicted and presented for tenable mitigation measure development. Project impact characteristics include whether

the impact is: adverse or beneficial; direct or indirect; short, medium, or long-term; and permanent; affecting a local, regional, or global scale; including trans-boundary; and cumulative or not. Each of these characteristics is addressed for every major impact identified during analyses.

Impact Evaluation: The significance of the predicted or identified impacts has been quantified and evaluated by considering the magnitude of the effect and the sensitivity, value, and importance of the affected resource or receptor. For the quantification and evaluation of impacts checklists and interaction matrices were methods applied for this purpose.

Each major impact is evaluated using the criteria assigned by experts' professional judgment based on the impact intensity, extent, duration, and sensitivity of the receiving biophysical and socio-cultural environment. The judgment of impact evaluation and significance has been determined based on the comparison of national/international laws, regulations, or accepted standards; consultation with the relevant decision-makers; reference to government policy objectives, and concern of the local community or the general public. After evaluation of impacts, appropriate and justified mitigation measures for the negative impacts and enhancement measures for the positive impacts are forwarded.

Table 19 Classification of Impact Evaluation

Classification	Description
Extent	Evaluation of the area of occurrence or influence of the impact on the subprogram environment; whether the impact will occur **on site**, in a limited area (**2km radius**); locally (**5km radius**); regionally (city-wide, nationally, or internationally).
Duration	Evaluation of the duration or persistence of impact on the subprogram environment, whether the impact was temporary (<1 year); short-term (1 – 5 years); medium-term (5 – 10 years); long-term (subprogram design period); or permanent (bound design period).
Sensitivity	Assessment of the impacts for sensitive receptors in terms of physical, ecological, social, and cultural settings, and major potential for stakeholder conflicts. The sensitivity classification is: **High sensitivity***:* Entire community Involuntary displacement, Property damage or Loss, biodiversity disturbance and species extinction, destruction of world heritage and important cultural sites, large-scale stakeholder conflict according to RPF, etc. **Medium sensitivity***:* Displacement of some households according to the RPF, moderate level of stakeholder concern, medium and reversible damage to the natural environment, etc **Low sensitivity***:* No displacements, no potential for stakeholder conflict, negligible

	impact on the natural environment, etc.
Severity (Overall Impact rating)	Using a combination of the above criteria, the overall severity of the impact was assigned a rating of Severe, Substantial, Moderate, Minor, and negligible. Note: These are just guidelines that will constitute professional judgment required in each individual case.

Impact severity: The impact severity was determined by professional experts by evaluating the intensity of the impact and the sensitivity of the environmental and social receptors, which is largely subjective. This is basically a semi-qualitative method designed to provide a broad ranking of the different potential impacts of a project. Impact severity assessment was done by assigning numerical descriptors to the impact intensity, as well as the environmental and social receptors, for each potential impact. The numerical descriptors are 1, 2, 3, or 4; which are equivalent to very low, low, medium, or high. The impact severity is then calculated as the product of the two numerical descriptors, which is equivalent to negligible, minor, moderate, or major, as indicated in Table 20.

Impact Significance: Impact significance is determined from an impact severity matrix which compares the severity of the impact with a probability of its occurrence. Impact significance criteria are as follows:

- ***Major:*** These denote that the impact is unacceptable and further mitigation measures must be implemented to reduce the significance. It is shaded red in Table 20.
- ***Moderate:*** 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 Yellow.
- ***Minor:*** Impacts in this region are considered acceptable. Shaded Gray.
- ***Negligible:*** Impacts in this region are almost not felt. Shaded Light green.

Table 20 Determination of impact severity

			Sensitivity of receptor			
			Very low	Low	Medium	High
			1	2	3	4
Impact intensity	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	4Minor	8 Moderate	12 Major	16 Major

The scale of intensity is defined on the basis of social and ecological considerationss and the expert's professional judgment Table 21.

Table 21 Intensity scale gradation for socio-environmental impacts

Intensity	**Criterion**
Very low	Environmental and Social changes are within the existing limits of natural variations or carrying capacity
Low	Environmental changes exceed the existing limits of natural variations. The natural environment is completely self-recoverable or renewable.
Medium	Environmental and social changes exceed the existing limits of natural variations and result in damage to the separate environmental components. The natural environment remains self-renewable.
High	Environmental and social changes result in significant disturbance to particular environmental components and ecosystems. Certain environmental components lose their self-recovering ability.

Table 22 Overall Impact Rating and Description

Impact Rating	Description of Impact	Significance
Major	✓ Non-compliance with national policy, environmental laws and regulations ✓ Highly noticeable, irreparable effect on the environment ✓ Significant, widespread, and permanent loss of resource ✓ Major defilement of water/air quality and noise guidelines representing a threat to human health in the long and short term ✓ Causing widespread nuisance both on and off-site ✓ Extensive property damage or loss,	>12
Moderate	• Noticeable effects on the environment and society, reversible over the long term. • Localized degradation of resources restricting the potential for further usage • Increased traffic in sensitive environments • Widespread physical resettlement, affecting livelihoods	6 – 12
Minor	○ Noticeable effects on the environment and society, but returning naturally to the original state in the medium term	2 – 4

	○ Slight local degradation of resources but not jeopardize further usage ○ A small contribution to global air problem through unavoidable releases ○ Infrequent localized nuisance ○ Population increase is not expected to stress existing infrastructure	
Negligible	➢ No noticeable or limited local effect upon the environment and society, rapidly returning to its original state by natural action ➢ Unlikely to affect resources to a noticeable degree ➢ No noticeable effects on regionally endangered species ➢ No significant contribution to the global air pollution problem ➢ Minor elevation in ambient water/air pollutant levels well below guidelines ➢ Temporary or intermittent changes to livelihoods or life quality aspects	< 2

Cumulative Impacts: Cumulative impact is the effect on the environment that results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions. Cumulative impact results from the aggregated effect of more than one project (or more than an action of the same project) occurring at the same time, or the aggregated effect of sequential projects. Cumulative effects manifest when socio-environmental conditions are already or will be affected by present, past, or rationally probable future developments or activities. The ESIA identifies current and probable future impacts of the WSC CWIS on the receiving environment.

8.2 Positive Environmental and Social Impacts and Their Enhancement

Fecal sludge management (FSM) is the collection, transport, treatment, and reuse or disposal of fecal sludge from pit latrines, septic tanks, or other onsite sanitation technologies. The development and operation of the proposed project will have substantial direct or indirect positive environmental and social impactson the local people, city, and region at large. Among others, some of the impacts include, improved sanitation facilities, enhanced water quality, Improved public health, hygiene and household health status, infrastructure improvement, Skill and technology transfer, and creation of employment opportunities during the construction and implementation phase of the project. Specifically, the following positive impacts are anticipated during the construction and operation phases of the project component:

8.2.1 Employment

The construction and operational phases of the project will provide a number of Employment opportunities for various disciplines. In this employment opportunity, both skilled and unskilled will potentially participate. Mostly temporary jobs will be created during construction phase and permanent jobs when the overall project is completed and starts operating. This job opportunity will be available for residents, especially for women, and youths, in the project area.

Project Phase	Construction	Operation	Decommissioning
When the impact will occur	✓	✓	✓

8.2.1.1. Enhancement measure

Unskilled and semi-skilled labor will be recruited preferentially from local communities, provided that they have the necessary experience, qualification, competence, and desired experience. Wherever feasible, local people should be considered for job opportunities commensurate with their level of skills. In this process especial considerations and priority have to be given to vulnerable groups of society like women, the youth, and the disabled should be given priority.

Adequate occupational health and safety standards training program for artisans (builders, carpenters, plumbers) in the project area has to be facilitated by the project to ensure skills transfer and ensure the work environment is conducive.

Information to create awareness about the proposed project activities will be provided to the PAPs targeting vulnerable (female-headed HH, people with disabilities, elderly, and others) and indigenous community groups.

8.2.2 Skill and Knowledge Transfer (Capacity Building)

The construction and operation of modern sanitation amenities is a new technology for our country and WST. It is expected that for the implementation of the proposed project, some degree of capacity building will be given (organized and un-organized) through the transfer of new technologies and new skills to (un-skilled) labor. Thus during construction and operation local skilled and unskilled workers will encounter and get experience from the FSTP installation, operation, maintenance, and management. This might be done through on-the-job training as well as through exposure to modern practices, management, and logistics procedures. Local

sub-contractors and companies are also beneficiaries of the transfer of skills and will also build additional local capacity.

Project Phase	Construction	Operation
When the impact will occur	✓	✓

8.2.2.1 Enhancement measures

Where the required knowledge and skills are available locally, the local people should be given first priority, particularly the vulnerable group, proportionate to their level of knowledge, skills, and interests. Programs and technical training courses as well as on-the- job training will be provided in specific skills areas for suitable candidates from local communities.

8.2.3 Income to material/ equipment suppliers and contractors

Some of the instruments and equipment may come from local or international areas. A number of equipment and materials (such as gravel, bricks, plumber, steel reinforcement, and cement for civil works) can be sourced locally within WST and the neighboring regions. So local suppliers of construction materials and equipment in the project area will benefit financially. This is a positive but short-term and reversible impact.

Project Phase	Construction	Operation
When the impact will occur	✓	

8.2.3.1 Enhancement measures

Construction materials might be supplied from legal or illegal suppliers but it has to be a contractual obligation for contractors to procure construction materials from quarries/suppliers legitimately licensed /legal by the respective district authorities. Work on local sourcing of construction materials that will boost the livelihoods of residents

8.2.4 Boost to the Local Economy

During the construction phase of the project, a relatively large number of the workforce (unskilled and skilled) were employed. The workforce will require and get most of their food and other necessities from the surrounding area and this will provide a market for the local agricultural producers, craft producers, and other small businesses (local shops). This will in turn increase the incomes of pity traders in the locality. Wages will quickly raise household income and stimulate the local economy. Business opportunities especially for locals as most of

them will be involved in small-time trades such as delivering food to site workers Thus the project will stimulate local economic activities by providing opportunities for the provision of basic and other services for the contractors and immediate community. Moreover, provision for direct employment, and trade opportunities for the local community is expected.

Project Phase	Construction	Operation
When the impact will occur	✓	

8.2.4.1 Enhancement measures

Provide adequate awareness about the business opportunity that that project has for the local community. Encourage vulnerable groups of the local community (women, youth,) to participate in pity trade activities.

8.2.5 Urban Service Infrastructure Improvement

The installation of fecal sludge treatment plants, public and communal toilets, or in general improved sanitation system of the city will increase the service delivery and contribute a lot to the development of the city, attracting investors and tourists. Modern waste management system infrastructure induces development, stimulates tourist attraction, and employment opportunities and helps improve the sanitation and hygiene level of the society.

Project Phase	Construction	Operation
When the impact will occur		✓

8.2.5.1 Enhancement measure

The infrastructure development should be of a type that is desirable and sustainable. For this to happen, all future development plans must be undertaken within the framework of proactive government policy and strict planning and environmental enforcement. Sustainability of the project is assured if the public/society at large participates actively in all stages of project development. Urban sanitation consists of the collection, storage/treatment, transportation, re-use, or disposal of excreta, liquid, and solid waste in ways that improve or sustain human health and decrease negative impacts on the environment.

To ensure the sustainability of the infrastructure service, effective and efficient utilization of the developed infrastructure and maintenance for the malfunction systems have to be done timely with the required standard. Recurrent societal training is required on awareness of waste management sustainable use and ownership of the developed infrastructure.

8.2.6 Improved Health Status of Households and Communities

Fecal sludge (FS) is the mixture of excreta, flush water, and anal cleansing material that accumulates in the containment. Fecal sludge can range from solid (with waterless toilets) to more fluid (with septic tanks). FS is highly hazardous for human health and for the environment. The provision of adequate sanitation facilities in urban and rural areas has positive impacts on the health of users by greatly reducing the incidence of communicable enteric and infectious related diseases.

Thus safe disposal of human excreta is one of the key measures to break the chain of transmission diseases. WST lacks adequate public and communal toilets and there are no sewage treatment facilities. The community denied such urban infrastructure. So the establishment of public toilets, and fecal sludge treatment plants in the short term will reduce and/or eliminate the indiscriminate disposal of human excreta and wastewater in the city. Enhanced sanitation facility in the city also contributes to the livelihood improvement directly or indirectly. The project has huge rules to control and reduce waterborne, communicable diseases and outbreaks. Due to the correct management of fecal sludge, improvement in the health, and sanitation of the public in particular and the city environment in general is expected.

Project Phase	Construction	Operation
When the impact will occur		✓

8.2.6.1Enhancement measures

Creating awareness for the general public on how to use and manage the wastewater treatment plant, proper use, regular cleaning, and effective maintenance of both the communal, household, and public toilet facilities. Educate users on the proper use, monitor the regular cleaning, and effective services of developed infrastructures. Ensure the required service and timely maintenance of communal, and public toilets and other related infrastructures.

8.2.7 Fertilizer and Biogas production

Fecal sludge that has been properly handled and allowed to mature can be used as fertilizer. The use of composted sludge (decomposed sludge) as fertilizer has a potential to improve crop yield and enable a reduction in cost for nitrogen and phosphorus mineral fertilizers. Moreover, Sludge application helps to reduce soil erosion and improves the soil quality as a plant growth medium and can help conserve soil organic matter, and sludge stimulates biological activity in the soil (Stamatiadis et al., 1999). Recycling of sludge for fertilizer and biogas energy

production and soil amendment is an appealing solution for the sustainable management of sludge. The biogas from sludge processing can be utilized as a substitute for natural gas or converted to heat and electricity.

8.2.7.1 Enhancement measures

Creating awareness for the general public about the potential advantage of treated fecal sludge as an alternative fertilizer chemical fertilizer and energy source is important. Encourage and participate people (vulnerable groups of the society) in compost preparation.

8.3 Negative Impacts and their Mitigation Measures

The implementation of the CWIS project in Wolayita city construction may have an adverse impact on the socioeconomic environment at large. The pre-construction and construction phases of the project involve planning and design resource mobilization transportation of construction materials, site clearing, land labeling, compaction, construction of access roads, and the project. Potential adverse impacts are presented as follows:

8.3.1 Construction Phase

8.3.1.1 Loss of vegetation cover

The proposed FSTP site is found within a manmade forest. This forest is typically composed of a single species (Eucalyptus) of fast-growing trees that are planted in rows or blocks and managed to maximize timber production. In line with this, there are tree, and shrub species observed. Even though monoculture plantations in the areaare observed, these forests play an important role in ecosystem services such as carbon sequestration, soil conservation, and water regulation.

Land clearing and removal of the existing trees, and vegetation can be a cause for, habitat loss, soil erosion, climate change, disruption of the water cycle, alteration of landscape integrity grasses, perennial vegetation, and change in land use pattern in the project area.

The impacts associated with loss of vegetation cover to the receptor sensitivity are considered to be “high”. The *intensity* of impact is assessed as ***medium*** resulting in major impact significance.

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

Mitigation strategies:

1. Re-vegetation of ¼ of the area delineated and the perimeters of the FSTP with commensurate amount of trees, bushes, and grasses lost during site clearance; as much as possible re-plant the indigenous vegetation as much as practical once work is completed
2. Store and reuse the topsoil removed from the site during site preparation properly ;
3. Spare the vegetation that must not necessarily be removed such as trees.
4. Minimize the amount of destruction caused by machinery by promoting no mechanized methods of vegetation removal.
5. Prior to undertaking vegetative clearance from environmentally sensitive areas the contractor shall seek approval from the relevant authorities and comply with the conditions provided
6. All areas planned for clearing of vegetation must be demarcated prior to the commencement of the construction;
7. A Wildlife Management system has to be emplaced by the Contractor during construction phase of the project.

8.3.1.2 Soil Degradation and Erosion

Site preparation will involve clearing strips of vegetation to allow for excavations to begin. Land clearing and removal of the existing vegetation can be a cause for the alteration of landscape integrity. Topsoil stripping during leveling and grading of the right of way (ROW) and the excavation of subsoil during trenching will break up the soil structure. Also, construction equipment engaged in activities (fecal sludge treatment plant) might cause light contaminations of soil due to leakage of fuels and lubricants from equipment. Moreover, Soils excavated may be exposed to agents of erosion. Prolonged storage of topsoil can lead to a loss in soil nutrients (leaching effect) and viability of seed bank in the soil.

Impact significance:

These are short-term and direct impacts. By considering the project footprint, receptor sensitivity is assessed to be low. Medium impact intensity is expected since the construction of FSTP will be done by a registered qualified contractor. The duration of exposure of stockpiles is relatively short and assuming the rugged terrain around the proposed FSTP, the sensitivity of the impact occurrence is medium. Thus both the **intensity** of the impact and ***sensitivity*** of the receptor are rated as moderate, which results moderate impact significance.

	Sensitivity of receptor

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

Mitigation strategies:

1. Develop a waste management plan prior to the start of construction activities;
2. Store topsoil and subsoil removed from the site during site preparation properly for reuse elsewhere or for backfilling and reinstatement. The valuable top soil containing organic material, nutrients as well as seeds, and the soil fauna should be excavated separately and piled in an adequate manner for re-use where applicable.
3. Protect the topsoil to retain the soil structure and minimize the risk of topsoil loss. Prevent the loss of fertility and degradation of the seed bank within stored topsoil. Keep the topsoil for as short a time as possible and use it for the rehabilitation of degraded land. Temporary spoil heaps will not be higher than 3m. Use the subsoil for backfilling of trenches.
4. Contour temporary and permanent access roads/laydown areas so as to minimize surface water runoff and erosion.
5. Avoid using old and properly unmaintained machinery which can most likely lead to oil, grease, and fuel leakages. Ensure that all equipment on duty is properly maintained and fully functioning to avoid oil and grease leakages;
6. Plan emergency response measures in case of accidental oil spills.
7. Develop a stable landform that mirrors the pre-disturbed condition (for instance contours, shape, level of compaction etc..) as this will minimize the risk of preferential erosion and therefore facilitate natural grass and bush recovery
8. All waste generated during site preparation and construction will be transported and disposed of to an authorized disposal area only. The contractor will seek guidance from the project office and on the final waste transportation and disposal site.
9. Excess soil must be removed from the site timely manner and deposited at an approved site; abandoned quarries be used for the disposal of excessive quantities of excavated soil material;
10. Protect adjacent areas of the construction site from disturbance and wherever possible construction work will take place during the dry season.

11. Work on the watershed management, especially for the upper catchment. Sheet and rill erosion of soil shall be prevented where necessary through the use of sand bags, diversion berms, culverts, or other physical means

12. Improve the vegetation cover of the open area by indigenous plant species diversity.

The adoption of the mitigation measures can reduce impact intensity to "**very low**" resulting in a residual impact of "**minor** significance".

8.3.1.3 Air Quality and Noise Pollution Dust Emissions

Dust emission: Project site clearing, earth works like leveling, trenching, excavation of top soil, vehicle movement over un-paved areas and other activities will generate fugitive dust. Actually elevated levels of dust emissions resulted in temporary. So the air quality in the construction sites along transportation routes of project pollution of gases expected from the engines. Major dust sources will be vehicle movement over un-paved areas and transportation of raw materials and equipment within the work site. The emissions of dust from construction activities will be localized and the dust is likely to settle in close proximity to the project. Sustained high levels of dust could impact negatively various groups of people who spend considerable time within the area adjacent to the project sites, such as construction workers and road side businesses, this aspect triggers the WB safeguard policy on Natural Habitats (OP/BP 4.04).

Air quality: In regions being excavated for trenches, pits, or ponds, along transportation routes, and at the building site, dust and engine pollution gases may accumulate. During dry times, this is probably going to happen. Emissions of CO_2, CO, SO_2, NO_X $PM_{5,}$ and $PM_{2.5}$ and other pollutants are produced by the continuous operation of trucks and equipment during the construction phase of the project. Moreover, some welding fume such as metal oxides (Fe_2O_3, SiO_2, K_2O, CaO) and CO, NO_x can be produced during the construction phase but this work happens in a short time and the impact is localized and temporary.

Noise pollution: The use of heavy equipment including bulldozers, graders, and dump trucks during site preparation and transportation of materials will generate noise and vibrations. The levels of noise generated will depend on the type and condition of equipment employed by the contractor, and the number of employs at a particular time. With noise being perceived as one of the most undesirable consequences of construction activity, it might become a nuisance to the settlements within its environs. Since the noise levels in the area are low or within the acceptable limit, the activities will therefore temporarily increase such levels. Generally, a construction phase noise level exceeding 70 decibels (dB) has significant impacts on surrounding sensitive receptors within 50m of the construction site.

Impact significance

Particularly the FSTP (fecal Sludge Treatment Plant) site has an ambient noise level with good air quality. The construction phase of the project might disturb the ambient conditions. The air quality impacts associated with dust generation, and noise pollution to the receptor sensitivity is considered to be "low". The ***intensity*** of impact is assessed as ***low*** resulting in **minor** impact significance.

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

Mitigation Measures

1. Construction workers will be made aware of the permissible noise levels at the workplace and surrounding environment
2. A construction truck driver, and machine operators have to be informed to switch off vehicle machine engines while offloading materials. According to Ethiopia Ambient Environment Standard Guideline (2003); noise levels at construction sites or industrial areas should not exceed 75 dBA and 70 dBA during the day and night, respectively;
3. It is the responsibility of the contractor to utilize well-maintained and functional working equipment. Old and malfunctioning working instruments will produce noise beyond the required level. The contractor has to ensure that all construction equipment's properly maintained and fully functional;
4. During periods of off-work time, equipment will be switched off whenever possible. A limited number of construction activities may have to continue on a 24-hour basis;
5. Movement of haulage vehicles be limited to day time since the noise impact will be less felt;
6. Whenever the dust emission is to become higher than expected and disturbance is created for the workers and project activities, it is recommended to spray the location with water to reduce the impact.
7. Workers be provided with the necessary personal protective equipment (PPE) such as ear muffs, and masks shall be availed to workers whenever needed and as found appropriate;
8. Workers operating near stationary emission emitting equipment/machinery generating noise levels greater than 80 dBA over long hours must be given PPE earmuffs.

Adoption of these mitigation measures will reduce impact intensity to "very low" resulting in a residual impact of **low** significance.

8.3.1.4 Traffic congestion

Traffic congestion is anticipated from the construction phase of the project. Contractor Heavy-duty truck traffic can obstruct or damage roads and increase the likelihood of accidents. The Fecal sludge treatment plant is found at "**Pundunia**" away from Wolayita Sodo to Arba Minch high way road. Traffic congestion to the receptor sensitivity is considered to be "low". The ***intensity*** of impact is assessed as ***low*** resulting in **minor** impact significance.

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

Mitigation Measures

1. The Contractor should provide temporary road signs or notices to indicate ongoing works;
2. The Consultant and Contractor should choose traffic routes to reduce the impact on the neighborhood and any sensitive areas;
3. Ensure that Vehicles for the construction work are operated only by qualified drivers;
4. All vehicles have to be parked only at designated parking areas and use spaces for loading and unloading;
5. All of the drivers have to obey the speed limit of vehicles and know the speed limits, particularly in residential areas;

8.3.1.5 Risk of Accident

Accidental risks associated with the project will be due to trenches created for the construction of people in the area including children moving for different purposes, and domestic and wild animals. Vehicles and trucks transporting construction materials to the site may result in community risk of traffic-related accidents especially if proper signals, and safe speed limits are not put in place or not adhered to. Construction traffic accidents would have a significant social impact and are likely to affect children, women, the disabled, elderly people, and livestock. Although some effects of the accidents (for instance minor injuries) may be reversible, some, for example, loss of human life are irreversible.

Impact Significance

The duration of the risk will be short-term occurring only during the construction phase. The receptor sensitivity is **Low** given that the number of people and animals along the roads and near the project area is minimum while the intensity is **Medium** given the temporary nature of the construction activities. However, some of the impacts like loss of life or severe physical damage may be irreversible. The impact significance is thus assessed to be **Moderate**.

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

Mitigation Measures

1. The contractor shall develop a TMP (Traffic Management Plan) and incorporate proposed arrangements for traffic diversions with details of all necessary budgets and signals.
2. Restrictions on hours of driving (including night time restrictions where sensitive receptors such as wild animals may be affected) and timing of vehicle movements will be emphasized to avoid busy periods in urban areas, particularly the start and end of school, market, and the working days.
3. No drivers or personnel under the influence of alcohol or any drug abuse shall be allowed onsite.
4. Travel speeds of construction vehicles along the road should be controlled by setting travel speeds and informing through signals.
5. Fencing or placing obstacles to trenches and ditches to avoid interference and accidents of wild and domestic animals and children.

Adoption of these mitigation measures will reduce impact intensity to “very low” resulting in a residual impact of **negligible** significance.

8.3.1.6 Solid Waste

Different types of solid wastes will be generated during the construction phase. Some of the wastes are characterized as organic and others inorganic wastes. This solid waste comes from vegetation clearance, excavation of rock, and soil works. Moreover, the other activities that will generate related solid wastes include packaging waste, stones, wood, broken glasses, containers, wire cuttings, metal scrap, wooden planks, sharp objects (nails), etc. If solid waste is

not properly managed, it can lead to health and safety issues related to accidents, and harboring dangerous animals. Therefore, this will have a major negative short-term impact on solid waste collection in the area. Construction activities wastes must be disposed of at authorized places in compliance with government rules.

Impact Significance

The likelihood of the impact occurring is **high**. The duration of the impact will generally be long-term if the water body is once polluted. The extent of the impact will be regional since the river is valuable for the surrounding ecosystem, a livelihood base for most, and a source of water. The ***intensity*** of the impact is assessed as ***Low*** where intensive sedimentation/ flooding during the rainy season around the river bank. The ***sensitivity*** of the receptor is **medium** given the close proximity of the selected FSTP to the aquatic environment. This results in an impact significance of **moderate**.

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

Mitigation Measures

1. Prepare site waste management plan (vegetation wood, broken glasses, containers, wire cuttings, metal scrap, wooden planks, sharp objects) prior to commencement of work, including appropriate waste storage areas, collection & and disposal schedule;
2. Materials from the excavation of the ground and foundation works shall be reused for Earthworks and landscaping;
3. Solid waste collection bins shall be placed at strategic locations within the site as collection centers to facilitate the separation and sorting of the various types of waste;
4. The wastes shall be properly segregated and separated to encourage the recycling of some useful resources;
5. The contractor and proponent shall work hand in hand to facilitate sound waste management.

8.3.1.7 Hazardous Wastes

Some of the wastes generated during the construction phase are categorized as hazardous wastes. The waste materials such as paints, cement, adhesives, Spill clean-up contaminated materials, and cleaning solvents will also be considered and managed as hazardous waste substances. Careless disposal of used containers for oil, lubricants, paint, and other toxic substances may pose a health hazard. Plastic containers are not biodegradable and can have long-term and cumulative effects on the environment. The storage and disposal of these waste streams have to be carefully performed so as to abide by the existing legal framework.

Hazardous waste poses risks or would have major and irreversible effects on both humans and the environment if it is not handled, stored, and disposed of according to engineering best practices. Hazard waste mishandling and uncontrolled disposal would have major health impacts on on-site workers, inhabitants in the project's area of influence, and people who get in contact with waste during transportation and disposal. The liquid form in particular liquid form, would cause soil contamination through direct contact or leaching and affect ground water quality through extended leaching. Thus the proposed project would require an adequate waste management strategy, occupational health and safety strategy, and hazardous material safety plan.

Impact Significance

The probability of impact occurrence is medium. The ***sensitivity*** of receptors is assessed as **'**medium' given that some project components particularly toilet sites are located in rural areas, close to green areas, youth recreational, and market centers. The impact intensity is assigned a ***low*** rating resulting in a ***moderate*** impact significance.

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

Mitigation Measures

1. The contractor has to develop mobile or temporary sanitary facilities in the construction site and in the vicinity of the project area which should be adequate at construction sites;
2. Segregate hazardous from the non-hazardous waste and keep it in suitable storage facilities at the project site.
3. Hazardous wastes such as paints, AC pipes, accessories, and adhesives should be properly sealed, labeled, secured, kept inside a locked fenced area to prevent access by

unauthorized personnel, and covered to prevent water accumulation before transportation.

4. A hazardous waste label that has a "Hazardous Waste" mark on it must be placed on the container while still at the generation point.
5. The contractor will be required to prepare a hazardous waste management plan that will ensure proper collection, storage, and transport to the identified disposal site;
6. Solid waste storage bins and/or skips are provided at the contractor's camp site and at the construction sites and ensure they are collected or emptied in time. Depending on the rate of accumulation, waste collection is made at least once in 24 hours and done in such a way as to minimize the nuisance of smell and dust during collection;

Adoption of the above mitigation measures will reduce impact intensity to "very low" resulting in a **residual** impact of **minor significance**.

8.3.1.8 Occupational Health and Safety (OHS) Risks

Workers' rights including occupational health and safety need to be considered to avoid accidents and injuries, and to ensure fair treatment, remuneration, and working conditions. Construction sites are considered the most potentially hazardous and accident-prone parts of any working Environment. Grinding and cutting, as well as masonry works, construction workers will be exposed to risks of accidents and injuries. In addition to this, excavation machinery and trenches may pose accident risks to workers either when equipment is operated by inexperienced workers or when the equipment is in poor mechanical condition. OHS risks might be aggravated by insufficient medical capability, neglect of safety equipment, precautions, and procedures on the construction site.

So according to the safety and health standards, every employee shall have sound knowledge of their susceptibility to harm or injury in the workplace. In the construction phase some causes of risks related to OH include lack of safety signage at specific and required areas, improper storage/ handling and use of dangerous substances/ chemicals, inadequate lighting and ventilation in workplaces, lifting of heavy and sharp objects, misuse of equipment and materials for functions they are not designed and others.

Impact Significance

Due to the high probability of occurrence and the high risk involved, accidents could cause considerable damage, financial loss, and harm to human life. While largely reversible, some impacts such as loss of human life and body injury are irreversible. The receptor *sensitivity* is considered a **medium given** that such impacts may be irreversible once they occur.

The impact *intensity* is considered to be **medium** resulting in **moderate impact significance**.

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

Mitigation Measures

1. The contractor shall prepare site-specific Health and Safety management Plan, moreover A qualified health and occupational safety officer will be recruited by the contractor to oversee OHS matters on a daily basis;
2. All construction workers will be oriented on safe work practices and guidelines (OHS) first and ensure that they adhere to them. All must be fully aware and mentally prepared for potential emergencies;
3. Workers must follow safety standards and use protective equipment to minimize hazards while trenching and excavating,
4. Appropriate signals will be used to warn staff and/ or visitors who are not involved in construction activities in dangerous places;
5. The contractor will provide first Aid kits and ensure the availability of trained first aiders within the construction site;
6. The contractor shall ensure that the campsite is fenced and hygienically kept with adequate provision of facilities including waste disposal receptacles, sewage, firefighting, and clean and safe water supply.
7. The contractor will ensure that its Code of Conduct is followed to regulate the performance and behavior of all workers. Personnel will only undertake tasks for which they are trained or qualified
8. The contractor will prohibit the use of alcohol, or ”Chat”, which could adversely affect the ability of the employee to perform the work safely or adversely affect the health and safety of other employees or the environment.
9. Adequate OHS personnel protective gear (such as nose, ear mask, and clothing) will be provided to the employees and good camp management shall be provided. Some of PPE include :
    - Face/Eye protection equipments like face shields, safety glasses, and goggles are vital in protecting the face from accidents.

- Ear-protecting instruments from the noise that exceeds over 80 Decibels for 8 hours a day requires ear muffs and plugs.
- For the hand use correct gloves for protecting the hand from chemicals and others.
- Foot protection boots are also important in the construction phase. Boots might be a toe, water, chemical, and non-slip type.

Adoption of these mitigation measures will reduce impact intensity to "very low" resulting in a residual impact of **negligible** significance.

8.3.1.9 Spread of communicable disease

Job seekers and other service providers, like food vendors would come from different places which might induce illicit contact and sexual relationships. The gatherings might result in spread of communicable diseases like sexually transmitted diseases (STDs), HIV-AIDS, and COVID-19. The project will employ more young workers at lower skill levels. This category of workers is prone to engage in high-risk sexual activity. Negligence in appropriate social distancing can aggravate the spread of COVID-19 and Irresponsible sexual relationships in project communities can break families and heighten the risk of contracting STDs.

Illicit contact or sexual relationships can be short-term but have long-term and irreversible effects if COVID-19, HIV, or Hepatitis-B were contracted. If this impact occurred, the extent of disease spread would be local, national, or international depending on the origin and next destination of infected persons.

Impact significance

Duration of the impact of COVID-19 is short-term or long-term based the contracted person recovers or passes away. In most cases elderly and immune-compromised (people who have a chronic illnesses like hypertension, diabetics, TV, cancer, HV/AIDS, etc.) individuals are contracted COVID-19 is deadly. Regarding HIV/AIDS duration of the impact will be short-term or long-term depending on whether HIV/AIDS is contracted or not. In both COVID-19 and HIV/AIDS cases the extent of the impact will be local or national depending on the origin and final destination of the construction worker.

The likelihood of the impact occurring is medium if the contractor do not adequately sensitize workers about responsible and safe behavior, proper social distancing, use of masks and gloves. On the other hand, the nature of the work can hinder social distancing through demand gathering together of more than two individuals for lifting up or moving big and heavy equipments during working hours.

The ***intensity*** of the impact is also medium given that COVID-19 has become pandemic. ***The sensitivity*** of the receptor is rated ***medium*** given that both COVID-19 and HIV/AIDS, if contracted, have a long-term effect. Therefore impact significance is ***moderate***

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

Mitigation Measures

1. As a contractual obligation, contractors shall be required to have an HIV/AIDS management plan (responsible staff, action plan, sensitization budget, and others) to implement during project construction;
2. The contractor shall prepare and enforce a Code of Ethical Conduct (CEC); in the camp to encourage respect for the local community and to maintain cleanliness of the camp at all times. The code of ethical conduct of workers has to be translated into the local language. The workers should periodically be sensitized on the code of conduct
3. All construction workers shall be orientated and sensitized about responsible sexual behavior in project communities. A safety, health, and environment induction course shall be conducted for all workers, putting more emphasis on HIV/AIDS, which has become a national disaster.
4. The contractor shall prepare an HIV/AIDS Awareness Campaign Plan to reduce the risks of spreading HIV/AIDS and other STDs as part of the contractual obligation.
5. Strategic planning for human resource development, preparation of capacity-building documents with explicit budget breakdown, and hiring of expatriates to deliver specialized training on Fecal sludge treatment.

8.3.1.10 Social Misdemeanour

Many societies have social norms and expectations that guide behavior and promote social cohesion. While these norms can vary across cultures and communities, they generally promote respect for others, civility, and consideration for the common good. Adhering to these social norms can help maintain a harmonious and functional society while violating them can lead to social disorder and conflict.

Due to the sudden increase of labor to project sites, this social misdemeanor might be affected. An influx of labor can have both positive and negative impacts on the local community. The

increased labor force may violet some social norms of the society and may result in incidences of Gender-Based Violence on the job site or in the neighborhood.

Impact Significance

The probability of impact occurrence is medium. The ***sensitivity*** of receptors is assessed as **'**medium' given that some project components particularly toilet sites are located in rural areas, close to green areas, youth recreational, and market centers. The impact intensity is assigned a ***low*** rating resulting in a ***moderate*** impact significance.

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

Mitigation Measures

- Unskilled and skilled (if available) labor should be hired from the local population as far as possible to minimize the influx of foreigners into the community.
- Effective communication and collaboration are key to addressing the challenges and opportunities presented by an influx of labor.
- Local governments, businesses, and community organizations work together to develop strategies for ensuring that workers are paid fair wages.
- Any new employee will be required to sign a code of behavior
- Awareness has to be given to the new comers about the norms of the project host community.

Adoption of the above mitigation measures will reduce impact intensity to "very low" resulting in a **residual** impact of **minor significance**.

8.3.1.11 Access road construction Impacts

The access road that will be constructed towards WST FSTP is vital for the construction and operation phase of the project. Hence gravel road which will be upgraded to Asphalt in the future. The proposed access road has to be constructed with its full at the required standard level. For this purpose road 2 Km length with 25m width and alignments is required.

The proposed access road area is government owned land and found at rural part of the town and hence little impact is expected issues related to Right Of Ways (ROW) and associated structures, link roads and interchanges. In fact in this particular project area, the access road is constructed with in the planned road line and space might be required for the walkaway, utility lines if any. During excavation and construction period adverse environmental impacts like deforestation, soil erosion, disruption of utility lines observed. To minimize the adverse impact utilize the mitigation measures listed down in the construction phase of the FSTP also holds true here.

The earthworks associated with access road site preparation may generate considerable quantities excavated soil. Soil erosion is most likely to occur during the construction period due to excavation, dredging, cutting and filling, removal of vegetation cover excessive noise and vibration.

Impact Significance

The probability of impact occurrence is medium . If waste If waste material is improperly managed and disposed of during construction of the roads, the impact duration would be short to medium term and the impact receptors are communities and water sources. The ***sensitivity*** of receptors is assessed as **'**medium' given that the project components is located in rural areas. The impact intensity is assigned a ***low*** rating resulting in a ***moderate*** impact significance.

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

Mitigation measures

- The roads have been designed to strictly follow the existing alignment;
- Work in close coordination with responsible utility line offices;
- The contractor shall, in consultation with the District Environment Officer and the supervising engineer identify suitable sites for temporary stockpiling of the cut to spoil material
- Use the stockpiling of the cut top soil for agricultural land amendment, restoration of borrow pits and quarries;

- The contractor shall develop and implement a stockpile management plan to guide in proper handling and management of these temporary stockpile sites;
- Develop alternative drainage to avoid localized floods;
- Unnecessary vegetation clearance will be avoided and develop landscaping at the end;
- Appropriate access road engineering designs and standards shall be adopted ;
- Soil holding structures/retention walls/gabion should be constructed in very loose soils especially ;
- Culvert outfall should be lined at an appropriate distance and designed to reduce soil erosion.

8.3.1.12 Physical Cultural Resources: Historical or archaeological artifacts

Physical Cultural Resources (PCRs) can be movable or immovable objects, sites, structures, or groups of structures having archaeological, paleontological, historical, architectural, religious, aesthetic, or other cultural significance. From the field visits / on-site survey and the stakeholder engagements held in the different project sites no graves, cultural or archaeological sites were seen or reported.

There are no legally protected cultural heritage areas at the project site. Consequently, the impact on culture heritage is insignificance from the proposed project. However, the Contractor should take precautionary measures during excavations just in case there are chance of finds procedure. Chance Finds Procedure (CFP) are procedures that have to be followed when an event of buried PCRs being unexpectedly encountered or a “chance find” during the construction phase of the project and duly reported to respected bodies.

8.3.2. Operation Phase Negative Impacts

8.3.2.1 Air Emissions, Dust and Odour

During the operation phase, there are no permanent point emission sources of air emissions except the stand-by diesel generators. Dust has the potential to cause a significant nuisance to people living close to the site and may pose a risk to the health of those working on the site, or visiting the site. Dust can be a problem, especially during the warm summer period, and during dry weather conditions. Given the scale and duration of the standby generators(emergency case only), and the comparatively small volumes of traffic (dust emission) that will be generated during the operation phase, the contribution of the proposed project to cumulative air quality impactsis considered to be of Minor Significance.

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

Dust and air emissions are inherent and cannot be completely eliminated. With few mitigation measures that can be applied at the locality will be enough. Like the regulation of speed to a suitable speed (20 km/h) for all vehicles entering the village's boundaries. Turn on generators only during power cut-off periods, implement preventive maintenance programs for vehicles and equipment, and promptly repair vehicles with visible exhaust fumes.

Odor: Fecal sludge treatment processes can generate foul odors and greenhouse gases, such as methane and carbon dioxide, which contribute to climate change and can also cause respiratory problems for nearby residents. Potential odor emissions from the sewerage plant would be the main concern during the operation phase. Odor can be generated from public and communal toilets, inlet works, grit chambers, and from sludge thickening and sludge storage areas of FSTP. Odors are the products of decomposition of organic matter. There may be unpleasant scents in and around the public and communal toilets as a result of the frequent interruptions in the water supply. Within the FSTP, odors are expected to be generated near the inlet open channels and screens; oxidation ponds, and sludge storage areas.

Different types of odors (ammonia, organic) might be produced especially from the handling of the waste when it is unloaded from the waste trucks at the sorting area or when leachates are generated and accumulated in storage ponds. The main constituent of these odors is hydrogen supplied (H_2S) due to its relatively high concentration in wastewater. This can be carried by wind to nearby settlements, thus unpleasant breathing environments. In general, the impact of odor nuisance, though localized, can be of immense magnitude, and will be permanent, and irreversible. Odor can be a significant problem for the people working in the waste treatment plant area and people living in the surroundings of the site.

Due to the location treatment site and wind direction the probability of the odor reaching the WSC is less but there are some industries near and around the selected treatment sites where the pungent odor may reach them.

Impact significance

The above impacts will affect the communities neighboring the FSTP, workers, and road users. Given the location of the project site's general wind direction the likelihood of the impact is **low** and the extent is local. The intensity of impact is assessed as low given that intensive greenery can serve as a wind break and sensitivity of the receptor becomes **medium**. The impact significance is therefore **moderate**.

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

Mitigation Measures

1. Plant indigenous trees at the perimeter of the project area with varying heights thereby forming wind breakers in addition to masonry or brick fences.
2. The project office must ensure proper operation to render unfriendly emissions during the discharge of treated leachates due to overloading of the systems or negligence of the operators.
3. Odors generated by the facility can be controlled by the use of suppressants and regular cleaning of the receiving areas;
4. Good site management of the operation must regularly ensure to avoidance of foul odors that would arise from improper functioning.
5. Use of Ferric chloride ($FeCl_3$) which will be added to control the generation of hydrogen sulfide (H_2S) the main source of odor in the sludge digestion process
6. Good maintenance of wastewater stabilization ponds, removal of accumulated debris and other solids at the inlets and outlets, removal of floating scum and floating macrophytes from the pond surface, and Repair of embankments which are eroded by rainfall or damaged by rodents and livestock grazing.
7. The volumetric BOD loading should lie between 100-400 g /m^3 in order to maintain anaerobic conditions and at the same time control odor release.
8. Conducting regular monitoring of the effluent to measure BOD levels and other key parameters, and adjusting the treatment process as necessary to ensure compliance with regulatory standards.

9. Using appropriate treatment technologies that are designed to remove organic matter and other contaminants from the fecal sludge.
10. Ensuring that the FSTP is properly maintained and that equipment is regularly serviced and repaired as needed to ensure proper functioning.
11. Implementing appropriate measures to manage and dispose of sludge generated during the treatment process, which may include dewatering, composting, or land application.
12. Regular maintenance and monitoring shall be undertaken to avoid accidental surface runoff intrusion from the manholes of the drainage network, which can overburden the facilities and cause foul odors.

Adoption of the aforesaid mitigation measures will reduce impact intensity to "**very low**" resulting in a **residual** impact of **minor significance**.

8.3.2.2 Polluting nearby water sources/channels

Improper treatment and disposal of fecal sludge can lead to the contamination of water sources, including groundwater and surface water. This can lead to the spread of waterborne diseases, such as cholera and typhoid fever. There could be soil and groundwater pollution if the proposed toilets and sludge treatment facility don't work as intended. Inadequate operation could potentially damage aquatic life and the environment as a whole by having a negative effect on the local population and the water quality of ground surface water which receives treated water sources. If appropriate design and construction methods and improper effluent management are not strictly followed, there is a possibility of ground or surface water pollution from leachate. This can be a results of overloading the system, breakdowns in operating machines, vehicles, and equipment causing deterioration of treatment efficiency.

The static water level in the area varies, with measurements ranging from 35.18m up to 41.22m, depending on the location. Specifically, in the study area west of Sodo town, the static water level is 40-50m, while in the upper catchment south of Sodo town; the static water level varies from 35.18m up to 36.42m.

Overall, these factors suggest that the area has the potential to support a significant amount of groundwater, particularly in the aquifer composed of coarse sand, pumice formation, fractured ignimbrite, and rhyolite tuff volcanic materials. However, the presence of fecal Sludge treatment sites and highly fractured rock formations may also pose potential risks to the quality of the groundwater in the area.

Impact Significance

The likelihood of the impact occurring is medium and its duration will generally be long-term if the water body is polluted. The *intensity* of the impact is assessed **as *medium*** given that the design and construction activity will be carefully done by the responsible bodies and the contractor. It is also believed that continuous monitoring mechanisms will be devised and in place to protect both ground and surface water from contamination. The extent of the impact is regional since the pollutants of surface and ground water may cover a large area through ground water flow. The *sensitivity* of the receptor is **high** given that once, it is contaminated treatment measures would be challenging and long-lasting; resulting in **major** impacts.

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

Mitigation Measures

1. Apply environmentally friendly fecal sludge treatment design, that should be constructed strictly following national and international building code standards;
2. Appropriate care has to be implemented throughout the project phases especially, during the construction phase of the project, standard working procedures of building code have to be followed to avoid errors of construction that may finally lead to leakage and contamination of the ground and nearby surface water.
3. Periodic implementation of surface water, springs, and groundwater testing points downstream of the project site and sampling and testing quarterly and taking appropriate measures when signals of contamination are detected;
4. Develop standard monitoring procedures for the FSTP facility and surrounding environ. Monitoring the normal operating functions of the system, environmentally sensitive receptors like ground and surface waters found nearby, and others.
5. Adopt a standardized operational management plan of FSTP which will help to control possible contamination form the implementation of the project;
6. Strict monitoring of chemical and biological loads entering the Fecal Sludge treatment plant and Swift adjustment of the treatment process to cater for overloads in effluent quality.

7. Establishing water & wastewater quality testing laboratory for the regular monitor of the effluent;
8. WSWSSA should ensure adequate operation and management of all the project components to avoid leakages and discharge of inadequately treated effluent;
9. Quarterly laboratory quality tests for effluent and receiving water resources will be done to ensure that the quality of effluent meets the national discharge standards or requirements;
10. Leakages from treatment ponds & and sludge drying beds should be avoided or minimized by regular monitoring & and maintenance of the network;
11. Groundwater monitoring typically involves installing monitoring wells at strategic locations around the facility. These wells allow for regular sampling and analysis of groundwater quality, which can help identify any changes or trends over time.
12. The awareness campaign will be launched every half a year for all the beneficiaries about the proper operation and maintenance of sanitation facilities put in place;
13. Emergency telephone Lines should be established to enable the public to immediately notify the PO of any damages to the sewer lines and other components of the network to ensure timely response and repair of such damages
14. Work and ensure that the FSTP, facility's effluent complies with the national effluent discharge limit standards
15. Protect the natural receptors technically throughan impermeable lower layer that prevents the leakage and infiltration of leachate from the facility. Incorporate the leachate drainage and collection networks as well as treatment mechanisms before moving to an offsite disposal area.
16. Ensure proper preventive and routine maintenance inspections of FSTP which will be vital to avoid breakdowns;
17. Regularly monitor the quality of effluent discharged from FSTP, against the effluent with discharge quality standards;
18. The treated Fecal Sludge should not be discharged directly into the nearby water body, rather the cake shall further it can be utilized in agriculture (compost), industry (briquettes), energy (biogas) production, Landscaping, and reclamation;

The adoption of the aforementioned mitigation measures can reduce impact intensity to "very low" resulting in a residual impact of "minor significance".

8.3.2.3 Occupational Health and Safety Risks

FSTP can pose several occupational health risks to workers involved in the collection, transportation, and treatment of fecal sludge. Fecal sludge contains a variety of harmful

pathogens, including bacteria, viruses, and parasites, which can cause serious infections and diseases. Untreated or improperly treated fecal sludge can lead to the spread of diseases and infections, such as diarrhea, hepatitis, and parasitic infections.

Workers who come into contact with fecal sludge, either directly or indirectly, may be at risk of exposure to these pathogens, Moreover, fecal sludge treatment can generate dust and fumes, which can cause respiratory problems and other health issues for workers who inhale them during the operational phases. Fecal sludge treatment facilities can be wet, slippery, and uneven, which can increase the risk of slips, trips, and falls. Some fecal sludge treatment processes involve the use of chemicals, such as disinfectants or cleaning agents, which can be harmful if not handled properly.

Workers at the facilities might experience work-related adverse health impacts, particularly during the operational and maintenance phases of the project. This is particularly observed if they do not have access to proper PPE or if they do not follow appropriate hygiene practices. So it is important to identify and mitigate occupational health risks associated with fecal sludge treatment to protect the health and safety of workers.

Impact significance

Accidents could cause considerable damage, financial loss, and harm to human life. While largely reversible, some impacts such as loss of human life and bodily injury are irreversible. The receptor **sensitivity** is considered **medium** given that although such impacts may be irreversible once they occur, the workers will get adequate training, provided with safety protective equipment, and will have done similar work and have knowledge on how to avoid such incidences. The impact **intensity** is considered to be **medium** since the project office will hire qualified experts who are aware of OHS measures; this gives rise to an impact of **moderate** significance.

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

Mitigation Measures

1. Hire qualified and trained OHS and environmental health crew for regular monitoring and management of FSTP;
2. To reduce occupational risks, FSTP Workers have to use appropriate PPE protection gear such as cut-resistant and high visibility protective clothing, gloves, safety boots(foot wares), appropriate respiratory protection equipment, face masks;
3. Develop and work on EHS (Environmental Health and Safety) Plan including health and safety measures to avoid accidents and injuries during work at the FSTP and implementing appropriate safety procedures.
4. Routine maintenance including the removal of garbage, screenings, and grit, slashing around the embankments, and repair of the fence shall be done timely;
5. Provide accessible easy-to-reach first aid and immediate medical care in case of injuries and accidents.
6. Vaccinate (Hepatitis) all labor working force at the site properly and provide regular health examinations access.
7. The FSTP should be fenced and signals put in place with security personnel to stop unauthorized people from accessing;
8. Exercise regular fumigation of the FSTP stores, administration rooms, and similar places to minimize, and kill disease vectors such as vermin, rodents, and mosquitoes;
9. An Accident Log will be maintained onsite to register all injuries and investigate their causes
10. Maintain important information on emergency resources (e.g., fire extinguishers, first aid kits, emergency contacts of a doctor, police men) in easily available places;
11. Strict follow operation in accordance with manufacturer's instructions and Material Safety Data Sheets (MSDS) procedures to store all chemicals utilized in FSTP and storage must conform to compatibility restrictions;

Overall, to mitigate occupational health risks associated with fecal sludge treatment to protect the health and safety of workers, the provision of appropriate PPE and adequate training, implementation of safety procedures, and creating of medical care access and support to the workers are equally important. The adoption of the aforementioned mitigation measures can reduce impact intensity to “very low” resulting in a residual impact of “minor significance”.

8.3.2.4. Fecal Sludge reuse

Fecal Sludge management and reuse involves the proper handling, treatment, and beneficial utilization of sludge. Sludge reuse can have environmental and social benefits like recovery of valuable nutrients, utilization is soil fertility improvement, reduction of waste, energy

generation, and others. However, reusing sludge may have adverse impacts. Fecal sludge may contain biological contaminants such as bacteria, viruses, and parasitic organisms; and chemical contaminants such as heavy metals, pharmaceuticals, and organic pollutants. Moreover, fecal sludge can result in odor and aesthetic Issues nuisance and discomfort to nearby communities if not properly managed. This can result in health risks for workers, nearby communities, and consumers if sludge is used in agricultural production.

Impact significance

The above impacts will affect the utilizers of fecal sludge, and communities neighboring the FSTP. Given the application of effective sludge management, appropriate treatment technologies, and regular monitoring and testing of sludge quality the potential risk intensity is **low,** and the sensitivity of the receptor becomes **medium.** The impact significance is therefore **moderate**.

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

Mitigation Measures

1. Utilize effective sludge management through careful planning, appropriate technologies, and regulatory requirements
2. minimize potential risk and ensure suitability of sludge reuse, by applying regular monitoring and testing of sludge quality
3. Conduct public health education campaigns to raise awareness among farmers, communities, and consumers about the safe use and benefits of fecal sludge.
4. Apply adequate treatment of fecal sludge through anaerobic digestion, composting, and thermal treatment.
5. Minimize worker's direct exposure to pathogens and contaminants through appropriate PPE and good hygiene practices
6. Engage with local communities, farmers, and other stakeholders to raise awareness about the safe use of fecal sludge and address concerns.
7. Provide training and capacity-building programs for personnel involved in fecal sludge management.

8.3.2.5 Landscape and Land Use Impacts

Land use, scenic, and visual quality: The construction of FSTP along the selected open area will permanently change the surrounding landscape scenery into a walled-in enclosure. The location, design, and appearance of public toilets can impact the scenic quality of an area.

Moreover, the cleanliness and maintenance of public toilets can impact the visual quality of an area. If public toilets are not well-maintained, it can create an unsightly and unpleasant visual appearance that detracts from the overall quality of the area. Conversely, a clean and well-maintained public toilet can improve the visual quality of an area by providing a necessary service to the community. During the operation phase, water stored in abandoned borrow pits in FSTP, toilets forms a breeding ground for vermin, mosquitoes, or other disease-causing and transmitting vectors, posing health risks to local communities and workers. There will be a significant negative aesthetic impact from the public toilets when toilets are constructed adjacent to schools and places of worship.

Impact significance

The duration of the impact will be long-term and the extent of the impact will be on-site. The intensity of the impact given to the proposed facilities the impact is **low**. The sensitivity of the receptor is rated **medium** given that no such projects have ever been established so far in the project-affected areas. Therefore, the significance of the impact is rated as **moderate**.

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

Mitigation measures

1. Select an appropriate location for public toilets which should be easily accessible and visible to users, located in a safe and well-lit area, and ideally near other public amenities like parks, playgrounds, and shopping areas;
2. Public toilets should have adequate ventilation. Proper ventilation to prevent the buildup of unpleasant odors and to maintain a healthy environment.
3. Restoration of borrow pits as close to pre-project maintenance conditions as possible should be done immediately ;

4. Native vegetation must be used for re-seeding the excavated site;
5. Monitor the regular cleaning of public toilets. Public toilets should be cleaned regularly to ensure that they are hygienic and free of odors;
6. Regular maintenance such as fixing leaks, repairing broken fixtures, and replacing damaged or worn-out parts of public toilets are important;
7. Regular Staff training has to be emphasized. The staff has to know cleaning techniques, maintenance procedures, and customer service and properly trained staff can help maintain public toilets effectively and efficiently.
8. Adoption of the aforesaid mitigation measures will reduce impact intensity to "**very low**" resulting in a residual impact of **negligible significance**.

8.3.3 Decommissioning Phase Negative impacts

The decommissioning process has to be planned and implemented carefully and systematically. To minimize potential environmental and social risks, decommissioning FSTP requires careful planning, engagement with local stakeholders, and adherence to applicable regulations and best practices. Some of the project activities in the decommissioning phase include proper cleaning, decontamination of the project site, dismantling of equipment and metallic structures, demolishing of concrete structure, appropriate disposal of hazardous materials, and transportation of recyclable and reusable materials for site restoration into its original or pre-project condition.

8.3.3.1 Pollution of Soil and Water bodies

Decommissioning a fecal sludge treatment plant can result in the release of contaminants or pollutants into the surrounding environment, particularly if the plant has not been properly maintained or cleaned. This can result in soil and water contamination, as well as potential health risks to wildlife and humans. Spillage of contaminated water, sludge, chemicals, grease, or oil is the main cause of soil contamination.

Impact significance

The effect of the impact will be long-term and the extent of the impact will be on site. Since a standardized working procedure was followed, the intensity of the impact given for kind of the proposed facilities is **low** but the sensitivity of the receptor is rated High given that the impact on the natural environment is a long term effect area. Therefore, the significance of the impact is rated as **moderate**.

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

Mitigation measure

1. Conduct a site assessment to identify potential environmental and health risks associated with the plant. Consider review of plant records, site inspections, and environmental sampling to identify potential contaminants or pollutants that may need to be addressed.
2. Develop a decommissioning plan that outlines the steps and working procedures for decommissioning of the plant
3. Engage local stakeholders in the decommissioning process to ensure that their concerns and needs are addressed.
4. Conducting environmental quality assessment of the water body and the treated wastewater prior to the commencement of the decommissioning
5. Properly transporting all the hazardous wastes construction materials, and chemical containers to a predetermined site for treatment, deposal or storage;
6. Topsoil and subsoil removed for decommissioning will be stored properly and used for backfilling and reinstatement;
7. Back-filling materials will be compacted to a level similar to the original surrounding soils to avoid subsidence as a consequence of rain water channeling;
8. Restore the project site to its original condition or to a condition that is acceptable to local stakeholders and regulatory authorities. Apply site grading, replanting vegetation, or other measures to restore the site to its natural state.
9. Monitor through regular sampling of soil, water, and air to identify any potential contaminants or pollutants, and can be used to ensure that the site is safe for future use.

8.3.3.2 Occupational Health and Safety and Air pollution

Decommissioning a fecal sludge treatment plant can pose several occupational risks to workers involved in the decommissioning process. Workers involved in decommissioning may be exposed to hazardous materials through inhalation, ingestion, or contact with the skin or eyes that can pose a risk to their health. Workers may also be exposed to biological hazards, such as harmful pathogens or infectious diseases, which can be present in fecal sludge. Moreover, workers might be exposed to physical hazards (Accidents, falls, and crushing injuries) when they

are working in confined spaces, with heavy equipment, or at heights. Certain tasks such as heavy lifting or awkward postures, can pose ergonomic hazards to workers, which can result in musculoskeletal disorders.

Impact significance

Accidents could cause considerable damage, financial loss, and harm to human life. While largely reversible, some impacts such as loss of human life and bodily injury are irreversible. The receptor **sensitivity** is considered **medium** given that although such impacts may be irreversible once they occur, the workers will get adequate training, provided with safety protective equipment, and will have done similar work and have knowledge on how to avoid such incidences. The impact **intensity** is considered to be **medium** since the project office will hire qualified experts who are aware of OHS measures; this gives rise to an impact of **moderate** significance.

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

Mitigation measures

To minimize these occupational health and safety risks, it is important to implement appropriate measures and procedures to protect workers. This can include:

1. Recruiting a qualified health and occupational safety officer who will oversee OHS matters on-site;
2. Proper induction of the workers prior to decommissioning commencement. Providing training and education to workers on the proper use of equipment, PPE, and hygiene practices;
3. Implement ergonomic interventions, such as job rotation or the use of assistive devices, to reduce ergonomic hazards.
4. Provide appropriate, adequate PPE, such as gloves, masks, and protective clothing, OHS personnel protective gear to the employees
5. Implementing engineering controls, such as ventilation systems and barriers, to reduce exposure to hazardous materials and physical hazards.

8.3.3.3 Socio-economy impact

Decommissioning a fecal sludge treatment will be stopped working and may have economic impacts on the surrounding community, particularly if the plant has been a source of employment or revenue. Decommissioning can result in **job losses** and reduced economic activity, which can have ripple effects on the local economy. Some unskilled workers will get temporary employment during the dismantling of the plants but the skilled workers that were hired to manage day to day operation of the FSTP are expected to lose their job during this phase.

Mitigation measure

1. Based on their skill, knowledge, experience, and interest, vulnerable community groups must be transferred to another secured job opportunity;
2. Provide financial assistance or grants to affected workers or businesses. This can involve providing loans, grants, or other forms of financial support to help workers or businesses transition to new opportunities;
3. Providing adequate provident fund or pension for those who want to retire;
4. Providing retraining programs in new industries or skills opportunities for workers who have been impacted by the process. Supporting workers to start their own businesses;
5. Repurposing the site for other uses, such as a park or community center, can help to mitigate the economic impact of decommissioning.

9. **Environmental Social Management Monitoring Plan (ESMP)**

An Environmental and Social Management Plan (ESMP) is a formal document that outlines the measures and actions that will be taken to mitigate potential environmental and social impacts associated with a project or activity. The ESMP summarizes the identified potential impacts, mitigation a measure for adverse impacts, expected out comes, indicators, monitoring, and evaluation. The ESMP report identifies parties responsible for management and monitoring actions, associated costs, indicators, and reporting.

9.1 Environmental and Social Management Plan (ESMP)

The ESMP is a critical component of ESIA because it takes the project-specific environmental and social safeguards as an integral part of the project for execution. The purpose of an ESMP is to ensure that potential environmental and social risks and impacts associated with a project or activity are identified, assessed, and effectively managed. The ESMP establishes acomprehensive framework that outlines the measures and actions that will be taken to minimize or eliminate negative impacts on the environment and local communities while promoting positive social and economic outcomes.

Table 23 Summary of Environmental and Social Management Plan

Phase	Adverse Impact	Mitigation measures	Responsibility	Budget in birr
Construction phase	Vegetation clearance	1. Once the work is completed re-vegetate the perimeters of the FSTP with indigenous/endemic plant species lost during site clearance; 2. Store and reuse the topsoil removed from the site during site preparation properly ; 3. Minimize the amount of destruction caused by machinery by promoting non-mechanized methods of vegetation removal; 4. All areas planned for clearing of vegetation must be demarcated prior to the commencement of the construction	EPA Contractor	100,000.00
Construction phase	Soil degradation	1. Develop excavated soil management plan prior to the start of construction activities; 2. Protect the topsoil to retain the soil structure and minimize the risk of topsoil loss; 3. Topsoil and subsoil removed from the site during site preparation will be stored properly (away from runoff and possible contaminants) for reuse elsewhere or for backfilling and reinstatement; 4. Contour temporary and permanent access roads/laydown areas so as to minimize surface water runoff and erosion; 5. Avoid using old (not more than 10 years) and properly unmaintained machinery which can most likely lead to oil, grease, and fuel leakages; 6. Ensure that all equipment on duty is properly maintained and fully functioning to avoid oil and grease leakages; 7. Excess soil/ cart away must be removed from the site on a daily basis and deposited at an authorized approved site ; 8. Protect adjacent areas of the construction site from disturbance and wherever possible construction work will take place during the dry season; 9. Prevent sheet and rill erosion of soil through the use of sand bags, diversion berms, culverts, or other physical means	Contractor	500,000.00
		1. Construction workers will be made aware of the permissible noise levels at the workplace and surrounding environment	Contractor	100,000

Construction Phase	**Air/ Noise pollution**	2. Noise levels at construction sites should not exceed 75 dBA and 70 dBA during the day and night, respectively 3. During periods of off work time, equipment will be switched off during off-work time whenever possible; 4. Utilize well-maintained and functional working equipment; 5. Avoid using old (> 10 years) or damaged equipment ones; on a weekly basis check every day proper functioning of all the machines on duty; 6. Trucks will be covered during haulage of construction materials to reduce spillage of materials and Use spray water for dust suppression over dusty areas 7. provide the necessary PPE (ear muffs, masks, etc.) to workers whenever needed and as found appropriate; 8. Adjust the travel speeds of construction vehicles to 30 Km/h along the road and should be controlled using traffic signals; 9. Avoid construction activities during night time.		
Construction Phase	Occupational Health and Safety (OHS) Risks	1. Prepare site-specific Health and Safety management Plan (work-related accidents, risk minimization, safe work practices, and guidelines training); 2. Assign a qualified health and occupational safety officer to oversee OHS matters on a daily basis; 3. Monitor construction workers on safe work practices and guidelines (OHS) and ensure that they adhere to them; 4. Provide training on OHS training before commencing work on site 5. Workers must follow safety standards and use protective equipment to minimize hazards 6. Standard Safety sign (OSHA) will be used to warn staff and/ or visitors about risk area 7. Provide first Aid kits and ensure availability of trained first aiders within the construction site; 8. Ensure that the campsite is fenced and hygienically kept with adequate provision of facilities (waste disposal receptacles, firefighting, and others); 9. Ensure the Code of Conduct is followed to regulate the performance and behavior of all workers.	WSWSSO and Contractor	700,000.00

		10. Personnel will only undertake tasks for which they are trained or qualified; 11. Implement ergonomic interventions, such as job rotation or use of assistive devices, to reduce ergonomic hazards 12. Prohibit the use of alcohol, or "Chat", in the work area; 13. Provide adequate OHS personnel protective gear (such as nose, ear mask, and clothing).		
Construction Phase	**Water Pollution**	1. Maintain and keep all construction equipment in standardized operating condition that can minimize oil, grease, or fuel leakages to the environment; 2. Perform routine maintenance of construction machinery and vehicles at a designated workshop or maintenance area and keep maintenance wastes separately; 3. Locate stockpile areas for (sand, gravel, stone, and topsoil), away from water courses and will be surrounded by a perimeter with sediment and other pollutant traps located at drain exits; 4. Use trained personnel for fuel and oil handling at the project site. Control the amount of fuel and oil spill leaks minimum; 5. Segregate and store all hazardous wastes and empty containers of hazardous materials in a designated area on site and dispose of them in accordance with the national hazardous waste management regulation; 6. Perform construction in the dry season to avoid sediment transport to the river.	WSWSSO and Contractor	500.000.00
Construction Phase	Slope Failure due to Earthworks	1. Protect very weak landform slopes by using engineered structures (slope stabilization measures, such as retaining walls, soil nails, or geotextiles); 2. Undertake all construction activities during the dry season which will minimize the risk; 3. Use the best available methods of construction technology to minimize the risk of blockages and constrictions; 4. Backfill and restore the eroded channels related to natural contours; 5. Protect the susceptible areas of the project by using temporary or permanent drainage works; 6. Perform Earthwork construction activity during the dry season by trained professionals who understand the risks and hazards associated with slope failure; 7. Monitoring the slope before and after the rainy season (two times) for signs of instability, such as cracks, bulges, or settling;	WSWSSO and Contractor	100,000.00

		8. Implement effective erosion control measures (re-vegetation, erosion control blankets, or sediment control basins).		
Construction Phase	**Solid wastes**	1. Prepare and apply solid waste management system (waste reduction, collection, sorting reuse, recycle, landfill) in the project site; 2. Reuse excavation of the ground and foundation works materials for Earthworks and landscaping; 3. Solid waste collection bins shall be placed at strategic locations within the site as collection centers to facilitate the separation and sorting of the various types of waste; 4. The Solid wastes shall be properly segregated and separated to encourage the recycling of some useful resources; 5. The contractor and proponent shall work hand in hand to facilitate the implementation of sound waste management.	WSWSSO and Contractor	100.000.00
Construction Phase	Hazardous Wastes	1. Develop temporary adequate sanitary facilities in the construction site or in the vicinity of the project area; 2. Segregate and classify Hazardous wastes from the non-hazardous and should be stored in suitable designated storage facilities at the project site; 3. Hazardous wastes such as paints, pipes, accessories, and adhesives should be properly sealed, labeled, secured, kept inside a locked fenced area to prevent access by unauthorized personnel, and covered to prevent water accumulation before transportation; 4. prepare a hazardous waste management (waste identification and classification, waste minimization, storage and transportation, treatment and disposal) plan; 5. Solid waste storage bins and/or skips are provided at the contractor's camp site and at the construction sites and ensure they are collected or emptied in time.	WSWSSO and Contractor	900,000.00
Construction Phase	Traffic congestion /Accident	1. Develop a Traffic Management Plan(traffic flow, control measures, work zone management, emergency response) and incorporate proposed arrangements for traffic diversions with details of all necessary budgets and signals; 2. Provide temporary road signs or notices to indicate ongoing works; 3. The client and Contractor should choose traffic routes to reduce the impact in the neighborhood and any sensitive areas;	WSWSSO and Contractor	100.000.00

		4. Ensure that vehicles for the construction work are operated only by qualified drivers; 5. Park all vehicles only at designated parking areas and use spaces for loading and unloading; 6. All of the drivers have to obey the speed limit of vehicles and know the speed limits, particularly in residential areas; 7. Travel speeds of construction vehicles along the road should be controlled by setting travel speeds and informing through signals; 8. No drivers or personnel under the influence of alcohol or any drug abuse will be allowed onsite; 9. Fencing or placing obstacles to trenches and ditches to avoid interference and accidents of wild and domestic animals and children.		
Construction Phase	Spread of communicable disease	1. Develop a communicable disease management plan (incidence monitoring, prevention control measures, case investigation, treatment, and care, etc); 2. prepare and enforce a Code of Ethical Conduct (CEC); in the camp to encourage respect for the local community and to maintain the cleanliness of the camp at all times; 3. The workers should periodically be sensitized on the Ethical code of conduct. Translate the code of ethical conduct local language; 4. Orient all construction workers and sensitize them about responsible sexual behavior in project communities; 5. A safety, health, and environment induction course shall be conducted for all workers two times per year, putting more emphasis on HIV/AIDS; 6. Prepare an awareness campaign plan to reduce the risks of spreading HIV/AIDS and other STDs as part of contractual obligation.	WSWSSO and Contractor	300,000.00
Construction Phase	Social Misdemeanor Conflicts	1. Hire unskilled and skilled labor from the local population as far as possible to minimize on influx of labor into the community; 2. Effective communication and collaboration are key to addressing the challenges and opportunities presented by an influx of labor; 3. Local governments, businesses, and community organizations to work together to develop strategies for ensuring that workers are paid fair wages; 4. Any new employee should be required to sign a code of behavior;	WSWSSO and Contractor	500,000.00

	due to the influx of labor	5. All construction workers shall be orientated and sensitized about responsible social behavior through Workplace education and training in project communities; 6. Awareness has to be given to the new comers about the norms, and cultures of the project host community.		
Operation Phase	Air Emissions, Dust and Odor	1. Plant indigenous trees at the perimeter of the FSTP project area with varying heights as wind breakers; 2. The project office must ensure proper operation to render unfriendly emissions during the discharge of treated leachates due to overloading of the systems or negligence of the operators; 3. Odors generated by the facility can be controlled by the use of suppressants and regular cleaning of the receiving areas; 4. Good site management of the operation must regularly ensure to avoidance of foul odors that would arise from improper functioning; 5. Use of Ferric chloride ($FeCl_3$) to control the generation of hydrogen sulfide (H_2S) the main source of odor in the sludge digestion process; 6. Good maintenance of FSTP stabilization ponds, removal of accumulated debris and other solids at the inlets and outlets, 7. Repair of embankments which are eroded by rainfall or damaged by rodents and livestock grazing; 8. Conducting regular monitoring of the effluent to measure BOD levels and other key parameters, and adjusting the treatment process as necessary to ensure compliance with regulatory standards. 9. Regular maintenance and monitoring shall be undertaken to avoid accidental surface runoff intrusion from the manholes of the drainage network, which can overburden the facilities and cause foul odors.	WSWSSO	500,000.00
Operation Phase	Polluting Water Resources	1. WSWSSA should ensure adequate operation and management of all the project components to avoid leakages and discharge of inadequately treated effluent; 2. The treated Fecal Sludge should not be discharged directly into the nearby water body, rather it can be utilized for Agricultural, industry, energy production, Landscaping, and reclamation;	WSWSSO	200,000.00

		3. Quarterly laboratory quality tests for effluent and receiving water resources will be done to ensure that the quality of effluent meets the national discharge standards or requirements; 4. Leakages from treatment ponds & and sludge drying beds should be avoided or minimized by regular monitoring & and maintenance of the network; 5. A maintenance crew should be in place to monitor and repair the fecal sludge treatment plant which is vital to prevent a damage or leakage and to avoid accidental surface runoff intrusion into water points; 6. The awareness campaign will be launched every half a year for all the beneficiaries about the proper operation and maintenance of sanitation facilities put in place; 7. Emergency telephone Lines should be established to enable the public to immediately notify the PO of any damages to the sewer lines and other components of the network to ensure timely response and repair of such damages		
Operation Phase	Occupational Health and Safety Risks	1. Hire qualified and trained environmental health/OHS for regular monitoring and management of the fecal sludge treatment plant; 2. FSTP Workers have to use appropriate personal protective equipment (PPE) proper protection gear such as cut-resistant and high visibility protective clothing, gloves, safety boots(foot wares), appropriate respiratory protection equipment, face masks; 3. Develop and work on EHS (Environmental Health and Safety) Plan including health and safety measures to avoid accidents and injuries ; 4. Routine maintenance including the removal of garbage, screenings, and grit, slashing around the embankments, and repair of the fence shall be done timely; 5. Providing appropriate training and equipment, and implementing appropriate ergonomic practices ; 6. Provide accessible easy to reach first aid and immediate medical care in case of injuries and accidents; 7. An Accident Log will be maintained onsite to register all injuries and to investigate their causes; 8. Vaccinate all labor working force at the site properly and provide regular health examination access;	WSWSSO	500,000.00

		9. The FSTP should be fenced and signals put in place with security personnel to stop unauthorized people from accessing; 10. Exercise regular fumigation of the FSTP stores, administration rooms, and similar places to minimize, and kill disease vectors such as vermin, rodents, and mosquitoes; 11. Maintain important information on emergency resources (e.g., fire extinguishers, first aid kits, emergency contacts of a doctor, police men) in easily available places; 12. Strict follow operation in accordance with manufacturer's instructions and Material Safety Data Sheets (MSDS) procedures to store all chemicals utilized in FSTP and storage must conform to compatibility restrictions;		
Operation Phase	Landscape and Land Use Impacts	1. Select an appropriate location for public /communal toilets which should be easily accessible/visible to users, and ideally near other public amenities like parks, playgrounds, and shopping areas; 2. The design of toilets should consider accessibility (disabilities), hygiene, durability, sustainability, aesthetics, and safety ; 3. Restoration of borrow pits as close to pre-project maintenance conditions as possible should be done immediately ; 4. Native vegetation must be used for re-seeding the excavated site 5. Public toilets should have adequate ventilation. Proper ventilation to prevent the buildup of unpleasant odors and to maintain a healthy environment; 6. Monitor the regular cleaning of public toilets. Public toilets should be cleaned regularly to ensure that they are hygienic and free of odors; 7. Regular maintenance such as fixing leaks, repairing broken fixtures, and replacing damaged or worn-out parts of public toilets are important. 8. Regular Staff training has to be emphasized. The staff has to know cleaning techniques, maintenance procedures, and customer service and properly trained staff can help maintain public toilets effectively and efficiently.	WSWSSO	300,000.000

Decommissioning Phase	Pollution of Soil and Water bodies	1. Develop a decommissioning plan that outlines the steps and working procedures for decommissioning of the plant 2. Engage local stakeholders, including nearby residents, businesses, and community organizations, in the decommissioning process 3. Conducting environmental quality assessment of the water body prior to the commencement of the decommissioning 4. Properly transporting all hazardous wastes construction materials, and chemical containers to a predetermined site for treatment, disposal or storage; 5. Topsoil and subsoil removed for decommissioning will be stored properly and used for backfilling and reinstatement; 6. Back-filling materials will be compacted to a level similar to the original surrounding soils to avoid subsidence as a consequence of rain water channeling 7. Monitor through regular sampling of soil, water, and air to identify any potential contaminants or pollutants,	WSWSSO	500.000.00
Decommissioning Phase	Occupational Health and Safety and Air pollution	1. Recruiting a qualified health and occupational safety officer who will oversee OHS matters on site; 2. Proper induction of the workers prior to decommissioning commencement. Providing training and education to workers on the proper use of equipment, PPE, and hygiene practices; 3. Implement ergonomic interventions, such as job rotation or use of assistive devices, to reduce ergonomic hazards; 4. Provide appropriate, adequate PPE, such as gloves, masks, and protective clothing, OHS personnel protective gear to the employees; 5. Implementing engineering controls, such as ventilation systems and barriers, to reduce exposure to hazardous materials and physical hazards; 6. Trucks will be covered during haulage of materials to reduce dust emissions	WSWSSO	800,000.00
Total Cost				6,700,000.00

9.2 Environmental Monitoring and Evaluation

Environmental monitoring and evaluation (EM&E) is a process used to measure and assess the impact of human activities on the environment. The goal of EM&E is to provide decision-makers with information that can be used to manage natural resources and protect ecosystems. EM&E is a critical component of environmental management, as it provides valuable information to decision-makers and stakeholders, allowing them to make informed decisions about how to manage natural resources and protect the environment.

The objective of environmental monitoring is to design a regular plan for the proper and timely execution of the mitigation measures and further help evaluate and design further remedial actions for unforeseen events. Monitoring involves the collection of data on environmental parameters such as air and water quality, soil characteristics, and biodiversity. This monitoring is important to assess the status of the environment during project operation, identify unexpected changes, and measure the effectiveness of the operational procedures, to confirm statutory and mandatory compliance. Hence, monitoring of identified mitigation measures is a key to sound environmental and social safeguard management, project sustainability, and community sense of ownership development.

The Wolayita Sodo Water Supply and Sewerage enterprise project office should establish both compliance and effects monitoring plans starting from the pre-construction phase.

Compliance monitoring involves assessing the extent to which regulations and standards are being met and can include inspections, audits, and enforcement activities.

The following Table 24 examines the extent to which the adverse impacts identified can be controlled through the adoption of mitigation measures.

Table 24 Environmental monitoring plan for CWIS Project at WSC

Adverse environmental Impact	Mitigation measures	Monitoring indicator	Method of monitoring	Monitoring institutions	Monitoring frequency	Phase/ status	Budget in birr
Water Resource Pollution	**1.** All construction equipment will be kept in good operating condition to avoid oil, grease, or fuel leakages	Maintenance/status reports Construction camp site observation	Observation & document		Throughout the construction phase	Constructi on phase	
	2. Poorly maintained machinery will not be allowed to operate on-site	Machinery catalog and status report	Observation & document	WEPO	Every month	Constructi on phase	
	3. Stockpile areas for materials such as sand, gravel, stone, and topsoil, as well as overburden dumps, will be located away from water courses	Water quality data; presence of erosion control facilities & pre(absence of eroded materials	Observation & document	WEPO	Every month	Constructi on phase	
	4. Fuel handling and oil spill measures will be implemented to prevent and control spills or leaks. Fuel and oil handling will be assigned to trained personnel and procedures for fuel storage, operation of mobile fuel tankers and refueling areas will be well-defined	Presence of trained personnel in charge of S & OHS; filed verifications of spill management procedures	Observation & document	WEPO	Throughout the construction phase	Constructi on phase	
	5. All hazardous wastes including materials soiled with hazardous wastes and empty containers of hazardous materials shall be stored in a designated area on-site for the regular removal	Location, condition of storage areas and packing; filed records of waste transfer & and disposal	Observation & document	WEPO	Every quarter throughout the construction period	Constructi on phase	200,000
	6. A Spill Kit will be maintained onsite to	Presence of spill kits	Observation	WEPO	Throughout	Constructi	45,000

Adverse environmental Impact	Mitigation measures	Monitoring indicator	Method of monitoring	Monitoring institutions	Monitoring frequency	Phase/ status	Budget in birr
	clean up any accidental spills.	at all project sites where there is potential for accidental spills	& document		construction phase	on phase	
Removal of Vegetation	1 Re-vegetation of ¼ of the area delineated and the perimeters of the FSTP with a commensurate amount of trees, bushes, and grasses lost during site clearance	Hectares of the FSTP covered with trees, bushes, and vegetation	Area re-vegetated	Municipality & WEPO of the city	Throughout construction phase	Constructi on phase	250,000
Soil erosion	2 Topsoil and subsoil removed from the site during site preparation will be stored properly (away from runoff and possible contaminants) for reuse elsewhere or for backfilling and reinstatement	documented verification of top & subsoil reused for backfilling, leveling & greening	Observation & document	WEPO	Throughout the construction phase	Constructi on phase	
Land use Pattern Alteration	3 The contractor will avoid the use of old(> 10 years) and damaged equipment, which can most likely lead to oil, grease, and fuel leakages	Protected and reused top and subsoil filed verifications documented	Observation & document	WEPO	Throughout the construction phase	Constructi on phase	
	4 During reinstatement, the trench back-fill material will be compacted to a level similar to the original surrounding soils to avoid subsidence as a consequence of rainwater channeling	Incidence of gullies or channels	Observation & document	WEPO	Throughout the construction phase	Constructi on phase	
	5 Recreation of a stable landform that mirrors the pre-disturbed condition	The visual appearance of the landscape	Observation & document	WEPO	Throughout the construction phase	Constructi on phase	300,000
	6 Upon completion of subsoil and topsoil reinstatement, disturbed areas will be	Documented Inception	Observation	WEPO	End of the construction	Constructi	

Adverse environmental Impact	Mitigation measures	Monitoring indicator	Method of monitoring	Monitoring institutions	Monitoring frequency	Phase/ status	Budget in birr
	inspected jointly by the contractor, and project office.		& document		phase	on phase	
	7 All wastes generated during site preparation and construction will be transported to an authorized disposal area	No complaints from communities around the site. No litter at the project site and complaints from Authorities	Observation & document	EPO	Entire construction phase	Constructi on phase	250,000
Improper hazardous and solid Management	1. The contractor develops mobile or temporary sanitary facilities on the construction site and in the vicinity of the project area	Presence of sanitary Convenience or facilities that are well Maintained	Observation & document	WEPO	Pre-construction phase	Constructi on phase	
	2. Hazardous wastes such as paints, asbestos Cement (AC) pipes accessories, and adhesives should be properly sealed, labeled, secured, kept inside a locked fenced area to prevent access by unauthorized personnel, and covered to prevent water accumulation	Presence and condition of the storage facility Records of waste disposal; Proof of waste delivery and safe disposal	Observation & document	WEPO	Entire construction phase	Constructi on phase	250,000
	3. The wastes are properly segregated and separated to encourage the recycling of some useful waste materials, that is, some excavated material can be used as backfills	Waste management plan	Observation & document	WEPO	Pre-construction phase	Constructi on phase	100,000
	4. Washing is not done in working areas but should be restricted to workers' camps and on paved areas to control runoff	Prepared washing site around the camp	Observation	WEPO	Entire construction phase	Constructi on phase	

Adverse environmental Impact	Mitigation measures	Monitoring indicator	Method of monitoring	Monitoring institutions	Monitoring frequency	Phase/ status	Budget in birr
			& document				
Air pollution	1. Trucks will be covered during haulage of construction materials to reduce spillage of materials and wherever dust suppression is necessary, water will be sprayed over dusty areas	Workers and local community opinions and suggestions on the Contractor's efforts to minimize dust nuisance	Observation & document	WEPO	Entire construction phase	Constructi on phase	
	2. Travel speeds of construction vehicles along the road (especially at public & and business centers) should be controlled using signals and setting travel speeds not exceeding 30km/h	Number of accidents and/ or complaints reported	Observation & document	Wolayita Sodo traffic office	Entire construction phase	Constructi on phase	300,000
	3. All surfaced roads shall be subject to road cleaning and not surfaced roads to dust suppression through traffic management techniques of the contractor	Nearby community opinions and documented reports	Observation & document	Wolayita Sodo Traffic office &WEPO	Entire construction phase	Constructi on phase	
	4. A maintenance program for equipment and vehicles will be implemented, to ensure air emissions like particulates, SOx, and NOx are minimized.	Air quality analyses, Vehicle and equipment maintenance schedule. Documented verification of equipment & vehicle maintenance	Air quality parameters analyzed Observation & document	Wolayita Sodo Traffic office & WEPO	Entire construction phase	Constructi on phase	

Adverse environmental Impact	Mitigation measures	Monitoring indicator	Method of monitoring	Monitoring institutions	Monitoring frequency	Phase/ status	Budget in birr
Disruption to Public Utilities	1..All road closures for the construction of the FSTP and PCT shall be separately notified and agreed upon with the transport and traffic office	Information communicated with the municipality	Observation & document	City Transport office	Entire construction phase	Construction phase	250,000
	2. Prior to the commencement of any civil works, the contractor must obtain from the utility agencies details of all utility locations within 50m of the works	Mapped and documented verification of all utilities within a 50m radius	Type and number of utilities Observation & and document	All affected utility offices	Pre-construction	Construction phase	350,000
	3. Damage to any utility at a defined site shall be restored and maintained to the satisfaction of the responsible agency at the contractor's cost. Damage to utilities not defined prior to construction, despite the contractor having undertaken all reasonable liaisons with the responsible agencies, shall not be the responsibility of the contractor	Documented evidence for No damages incurred; when they happen, remedial measures implemented to the satisfaction of the utility agency	Observation & document	All affected utility offices	Entire construction phase	Construction phase	
	4. The tender documents shall contain sufficient information on utility crossings to permit the contractor to include the cost of the works for which she/he is responsible in her/ his bid	Cost implication in the bid document to manage disruption of utilities	Observation & document	All affected utility offices	Entire construction phase	Construction phase	
	5. Disruptions to public access shall be identified in the Contractor's Traffic Management Plan (CTMP), under which suitable notice of intending delays and closures is given to all concerned parties and approved prior to commencing work	CTMP	Observation & document	All affected utility offices	Pre-construction	Construction phase	

Adverse environmental Impact	Mitigation measures	Monitoring indicator	Method of monitoring	Monitoring institutions	Monitoring frequency	Phase/ status	Budget in birr
Disruption of private Communication Routes	1. Access to or from an individual property should not be closed for more than 2 hours	Documented verification and property owners' opinions	Observation & document	WEPO	Entire construction phase		
	2. Vehicular access to and from hospitals, police stations, and fire stations shall be maintained through the use of steel road plates over open trenches. Pedestrian access to schools, health facilities, and other premises frequently accessed by the public will be maintained with the use of walking boards	Documented verification from municipality and public opinions	Observation & document	Transport & Traffic management office	Entire construction phase	Construction phase	
	3. Backfilling, installation of sewer aqueducts, and temporary reinstatement shall be completed within 2 weeks after trench excavations. It should not extend 2 weeks after excavation	Local community opinions & and documented verifications	Observation & document	Transport & Traffic management office	Entire construction phase	Construction phase	
Risk of Accident	1. All workers will undergo an OHS and environmental induction before commencing work on-site	Documented induction material and plan	Observation & document	WEPO & Social Affairs office	Entire construction phase	Construction phase	
	2. The contractor shall incorporate his proposed arrangements for traffic diversions in the form of a Traffic Management Plan in the bid document, with details of all necessary budget and signals	Traffic Management Plan with Budget Indications	Observation & document	Transport & Traffic management office	Pre-construction	Construction phase	

Adverse environmental Impact	Mitigation measures	Monitoring indicator	Method of monitoring	Monitoring institutions	Monitoring frequency	Phase/ status	Budget in birr
	3. Restrictions on hours of driving (including nighttime restrictions where sensitive receptors may be affected) and timing of vehicle movements will be emphasized to avoid busy periods in urban areas, particularly the start and end of school and the working day	Traffic Management Plan	Observation & document	Transport & Traffic management office	Entire construction phase	Construction phase	
	4.No drivers or personnel under the influence of alcohol or any drug abuse will be allowed onsite	Traffic Management Plan & a special induction plan for drivers	Observation & document	Transport & Traffic management office	Entire construction phase	Construction phase	
	5. Travel speeds of construction vehicles along the road especially at public and business centers like schools, hospitals, and the market areas should be controlled using signals, flagmen, and setting travel speeds not exceeding 30km/h	Documented evidence of signals and speed limits put in place	Observation & document	Transport & Traffic management office	Entire construction phase	Construction phase	
Noise pollution	1) Construction workers will be made aware of the permissible noise levels at the workplace and surrounding environment	IFC(2007) EHS &Ethiopia Ambient Environment Standard (2003)	Observation & document	WEPO	Entire construction phase	Construction phase	400,000
	2) The contractor will be careful when selecting the working equipment to avoid the use of old or damaged ones; besides checking the day proper functioning of all the machines on duty	Site noise level testing, workers' reflections	Observation & document	WEPO	Entire construction phase	Construction phase	300,000
	3) All generators and heavy-duty equipment will be insulated or placed in enclosures to minimize disrupting ambient noise levels	Site inspection & workers' reflections	Observation & document	WEPO	Entire construction phase	Construction phase	

Adverse environmental Impact	Mitigation measures	Monitoring indicator	Method of monitoring	Monitoring institutions	Monitoring frequency	Phase/ status	Budget in birr
	4) During periods of off-work time, equipment will be switched off whenever possible. A limited number of construction activities may have to continue on a 24-hour basis.	Site noise level test inspection & and workers reflections	Observation & document	WEPO	Entire construction phase	Construction phase	
	5) No construction activities of public toilets and PS near religious institutions will take place on Sundays and holidays.	Site noise level test & and church governing body reflections	Observation & noise level test, document	WEPO	Entire construction phase	Construction phase	
	6) No construction activities will take place at night for sites with close proximity to residential houses	Site noise level test & and residents reflections	Observation & document	WEPO	Entire construction phase	Construction phase	
Property damages and loss	1. Build a replacement sheepkeeping house for the female-headed household before demolishing the existing sheepkeeping house/relocating the construction site	Construction of a replacement house	Observation	WSWSSO	One –Off	Pre-construction	300,000.00
	2. Determine the size of areas required for the safe operation of construction before clearing vegetables, plants, and trees	Project design and site map	Measurement	WSEPA and WSWSSO	One –Off	Pre-construction	
	3. Plant new plants and vegetables on movable objects like pots, bowls, bottles, cans, and so on upon their uprooting	Number of vegetables planted on movable objects	Observation & document	WSEPA and WSWSSO	One –Off	Pre-construction	
	4. Plant replacement trees and plants at the end of construction	Number of trees planted at the end of construction	Observation & document	WSEPA and WSWSSO	One –Off	At the end of the construction	

Adverse environmental Impact	Mitigation measures	Monitoring indicator	Method of monitoring	Monitoring institutions	Monitoring frequency	Phase/ status	Budget in birr
	5. Repair damaged property to the owner's satisfaction	Satisfaction and acceptance of property owner	Observation & interview	WSWSSO	Continuous	during the entire construction activities	
Disruption of Access to Toilet Facilities	1. Prepare temporary toilets before demolishing the existing toilets	Construction of temporary toilet	Observation	WSEPA and WSWSSO	One-Off	Pre-construction	250,000.00
	2. Disposal of demolished structures and materials should be done with the approval and supervision of the Client	Location, condition of, and filed records of disposed materials;	Observation and document	WSEPA and WSWSSO	One-Off	Pre-construction	
	3. Prevent the spread of fibers or dust by segregating and covering asbestos/cemented materials during demolition	Location, condition of, and filed records of disposed materials;	Observation and document	WSEPA and WSWSSO	One-Off	Pre-construction	
Barriers to access to roads and movement	1. Construction materials dumping places should be selected in consultation with residents living near construction sites	Minutes of consultation	Observation , Interview, and Document	WSWSSO and WSEPA	One-Off	Pre-construction	400,000.00
	2. Notify residents living closer to the construction site about the closure of roads before twenty-four hours, and access to and from doorsteps should not be closed for more than two hours	Site visits and opinion of the local community	Observation and Interview	WSWSSO and WS Police and Traffic Office	Continuous	During construction	

Adverse environmental Impact	Mitigation measures	Monitoring indicator	Method of monitoring	Monitoring institutions	Monitoring frequency	Phase/ status	Budget in birr
	3. Opening alternative routes if road closure extends beyond two hours	Site visit and number of new routes opened	Observation and filed document	WSWSSO and WS Police and Traffic Office	Continuous	During construction	
	4. Construction materials and equipment should be dumped and placed in a manner that would not disrupt other activities in the market and condominium houses	Site visits and opinions of people affected by dumped materials	Observation and Interview	WSWSSO and WSEPA	Continuous	During construction	
	5. Construction debris/ waste materials should be removed from construction sites on a daily basis	Site visits and opinions of people affected by construction debris	Observation and Interview	WSWSSO and WSEPA	Continuous	During construction	
Proliferation of conflict and deviance	Unskilled laborers should be hired from the local community	Number of people hired in the project	Observation and records of lists of employees	WSWSSO and WSCJCEDO	Continuous	Operational phase	350,000.00
	PTs should be handed over to unemployed youths and women in the area to run them by organizing small and medium-scale enterprises	Number of people organized from subproject area to run PT facilities	Documents and interviews	WSWSSO and WSCJCEDO	After project completion	Operational phase	
	Awareness creation training should be given to workers to maintain harmonious relationships with the local community, to avoid illicit sexual intercourse with teenage girls, and to practice safe sex if it is between two consenting adults	Site visits, documents and records of training, and opinions of workers and local community	Observation, documents, and interview	WSWSSO and WSCHO	One-Off	Pre-construction	

Adverse environmental Impact	Mitigation measures	Monitoring indicator	Method of monitoring	Monitoring institutions	Monitoring frequency	Phase/ status	Budget in birr
Structures inaccessible for PWDs	Two flush toilets with an iron bar for females and males should be built in all PT and CT facilities in order to ensure PWDS-friendly services	Number of flush toilets and iron bars constructed	Observation and document	WSWSSO	One-Off	During construction	400,000.00
	Drainages found along roads in PT sites should be covered with slabs in order to ensure safe and yeasy crossing toward toilet facilities for PWDs	Number of drainages covered by slabs located alongside roads	Observation and document	WSWSSO	One-Off	During construction	
	PTs located on hilltops should be connected to roads by building ramps or steps in order to ensure toilet facilities are accessible to PWDs	Number of ramps constructed connecting to PTs	Observation and document	WSWSSO	One-Off	Operational phase	
Occupational Health and Safety Risks	1) A qualified health and occupational safety officer will be recruited by the contractor to oversee OHS matters on a daily basis	Presence of a qualified OHS officer	Observation & document	WEPO	Throughout construction	Construction phase	250,000
	2) All construction workers will be oriented on safe work practices and guidelines and ensure that they adhere to them	Induction plan & and records of verification of workers' orientation	Observation & document	City social affairs office	Pre-construction phase	Construction phase	
	3) Appropriate signals will be used to warn staff and/ or visitors who are not involved in construction activities in dangerous places	Presence of signals	Observation & document	WEPO	Pre-construction phase	Construction phase	
	4) Personnel will only undertake tasks for which they are trained or qualified	Verification documents for personnel	Observation & document	WEPO	Entire construction	Construction phase	
	5) Communication line will be ensured between workers and drivers of heavy equipment	Plan for temporary routes	Observation & document	WEPO	Entire construction	Construction phase	

Adverse environmental Impact	Mitigation measures	Monitoring indicator	Method of monitoring	Monitoring institutions	Monitoring frequency	Phase/ status	Budget in birr
	6) Adequate OHS personnel protective gear will be provided to the employees	Budgeted verification of protective cloth	Observation & document	WEPO	Entire construction	Construction phase	
Social Misdemeanor by Workers	1) As a contractual obligation, contractors shall be required to have an HIV/AIDS management plan (responsible staff, action plan, sensitization budget, and others) to implement during project construction	HIV/AIDS management plan	Observation & document	City Health bureau	Entire construction phase	Construction phase	
	2) All construction workers shall be orientated and sensitized about responsible sexual behavior in project communities;	Interview with workers and induction manual in place	Observation & document	City Health bureau	Entire construction phase	Construction phase	
Polluting Water Resources	1) Establishing water & wastewater quality testing laboratory for the regular monitoring of the effluent;	Wastewater quality measurement	Observation , number, and type of wastewater quality tested		Entire Operation phase	Operation phase	200,000
	2) FSTP should ensure adequate operation and management of all the project components to avoid leakages and discharge of inadequately treated effluent;	Quarterly wastewater quality monitoring	Observation & document	WEPO	Entire Operation phase	Operation phase	
	3) Leakages from toilets, treatment ponds & and sludge drying beds will be avoided or minimized by regular monitoring & and maintenance of the network		Observation & document	WEPO	Entire operation phase	Operation phase	

Adverse environmental Impact	Mitigation measures	Monitoring indicator	Method of monitoring	Monitoring institutions	Monitoring frequency	Phase/ status	Budget in birr
	4) A maintenance crew will be put in place to monitor and repair the sewage network immediately a damage or leakage occurs to avoid accidental surface runoff intrusion into water points	Site inspection, public opinions, system regular maintenance & follow-up	Observation & document		Entire operation phase	Operation phase	
	5) Maintain, repair, and refuel vehicles and machinery at an offsite garage or workshop	Qualified, experienced & well-equipped staff in place	Observation & document		Entire operation phase	Operation phase	
	6) Quarterly laboratory quality tests for effluent and receiving water resources will be done to ensure that the quality of effluent meets the national discharge standards or requirements	Site visit of the workshop	Observation & document	City Transport office	Entire operation phase		
	7) The awareness campaign will be launched every half a year for all the beneficiaries about the proper operation and maintenance of sanitation facilities put in place	National Ambient Environment Standard (2003)	Observation & document	WEPO	Entire operation phase	Operation phase	250,000
	8) Emergency telephone Lines should be established to enable the public to immediately notify the PO of any damages to the sewer lines and other components of the network to ensure timely response and repair of such damages	Documented verification of public awareness campaign guideline	Observation & document	Major office	Entire operation phase	Operation phase	
	1) The project staff will be trained for proper management of screenings and sludge to avoid soil contamination	Number of waste collecting bins in place	Observation & document	WEPO	Entire operation phase	Operation phase	250,000

Adverse environmental Impact	Mitigation measures	Monitoring indicator	Method of monitoring	Monitoring institutions	Monitoring frequency	Phase/ status	Budget in birr
Land Degradation and Soil Erosion	2) The dried sludge shall be removed regularly from the sludge drying area and shall be given to local interested farmers as soil conditioner or taken to tip and should not burnt	Soil waste is well managed and no soil contamination record due to the project	Observation & document	WEPO	Entire operation phase	Operation phase	
	3) Periodic tests will be done to ensure the quality of effluent and treated sludge,	Follow-up and maintenance plan to avoid accidental surface runoff	Observation & document, Sludge quality tests	WEPO	Entire operation phase	Operation phase	250,000
	1) During operation water impounded in derelict borrow pits should be immediately removed and the site should be restored to its natural conditions to avoid breeding of mosquitoes, vermin, and other insects		Observation & document	WEPO	Entire operation phase	Operation phase	
Landscape, Land Use Impacts	2) Restoration of borrow pits as close to pre-project maintenance conditions as possible will be done immediately after use in cases where they are opened for maintenance and repair of the project. Native vegetation must be used for re-seeding the excavated site	Site visit, local community, and workers' reflections	Observation & document	Health bureau	Entire operation phase	Operation phase	
	3) Where sections of the road and other public amenities are cut, these will be reinstated immediately after maintenance activities of any of the project components	Site inspection & and local community reflection	Observation & document	WEPO	Entire operation phase	Operation phase	

Adverse environmental Impact	Mitigation measures	Monitoring indicator	Method of monitoring	Monitoring institutions	Monitoring frequency	Phase/ status	Budget in birr
Air Pollution	1) The perimeter of the proposed sites will be vegetated with trees, bushes grasses, and plants of varying heights thereby forming windbreakers in addition to chain link fences		Observation & document	WEPO & Mayor's office	Entire operation phase	Operation phase	
	2) Regularly the FSTP will ensure adequate operation and management of the facilities to avoid obnoxious smell that would arise from dysfunctional	Well-organized and developed operation manual; information level of the workers to use the manual	Observation & document	WEPO	Entire operation phase	Operation phase	
	3) Regular maintenance and monitoring will be taken to avoid accidental surface runoff intrusion from the manholes of the sewage network, which can overburden the facilities and cause foul odors	No obnoxious smell grievance from workers & and the local residential communities	Observation & document	WEPO	Entire operation phase	Operation phase	
Occupational Health and Safety Risks	1) Qualified and trained OHS and environmental health crew must be hired for regular community sensitization, capacity development, management, and monitoring of social and environmental issues		Observation & document		Entire operation phase	Operation phase	
	2) Adequate OHS personnel protective equipment (PPE) gears will be provided to the employees	Presence of qualified OHS officer with well-organized qualification documents	Observation & document		Entire operation phase	Operation phase	

Adverse environmental Impact	Mitigation measures	Monitoring indicator	Method of monitoring	Monitoring institutions	Monitoring frequency	Phase/ status	Budget in birr
	3) Routine maintenance including but not limited to facilities involved in the removal of garbage and grit screenings, slashing around the embankments & repairing damages to the fence	Record of PPE provided and staff; use of PPE on site	Observation & document		Entire operation phase	Operation phase	
	4) The site, where possible, will be fenced and signalization put in place with security personnel to stop unauthorized people from accessing the site	Clean, green conducive work environment and fences well managed	Observation & document		Entire operation phase	Operation phase	
	5) The manufacturer's instructions and Material Safety Data Sheets (MSDS) must be followed for the storage of all chemicals used in sewage treatment	Well-established security system	Observation & document		Entire operation phase	Operation phase	
	6) Regular fumigation of the Plant will be undertaken to kill disease vectors such as vermin and mosquitoes	Absence or presence of chemical usage or handling related spillage to the environment	Observation & document	WEPO	Entire operation phase	Operation phase	
	7) An Accident Log will be maintained onsite to register all injuries and investigate their causes	Stockpile of chemicals for fumigation; public opinion regarding proper use	Observation & document	WEPO & Health Bureau	Entire operation phase	Operation phase	
	8) Emergency resources (e.g., fire extinguishers, stocked First Aid kits, Emergency Contacts, Doctor and policy men on Call)	Documented accident log	Observation & document	WEPO & Health Bureau	Entire operation phase	Operation phase	

Adverse environmental Impact	Mitigation measures	Monitoring indicator	Method of monitoring	Monitoring institutions	Monitoring frequency	Phase/ status	Budget in birr
Pollution of Soil and Water bodies	1. Properly transporting all the metallic, AC pipes, and chemical containers to a predetermined site for deposal or storage	Standby emergency communication facilities	Observation & document	Policy Office & Health Bureau	During commissioning	Decommissioning phase	
	2. Topsoil and subsoil removed for decommissioning will be stored properly and used for backfilling and reinstatement	Documented evidence of the	Observation & document	WEPO	During commissioning	Decommissioning phase	
	3. Back-filling materials will be compacted to a level similar to the original surrounding soils to avoid subsidence as a consequence of rainwater channeling	Volume or meter cube of soil used	Observation & document	WEPO	During commissioning	Decommissioning phase	
	4. Conducting environmental quality assessment of the water body prior to the commencement of the decommissioning	Documented evidence of materials used	Observation & document	WEPO	During commissioning	Decommissioning phase	
Occupational Health and Safety and Air pollution	1. A qualified health and occupational safety officer will be recruited to oversee OHS matters on-site	Water analyzed	Observation, tested water quality parameters & document	WEPO	Start of the commissioning phase	Decommissioning phase	
	2. Proper induction of the workers prior to work decommissioning commencement	Number of quality professionals who document	Observation & document		Start of the commissioning phase	Decommissioning phase	

Adverse environmental Impact	Mitigation measures	Monitoring indicator	Method of monitoring	Monitoring institutions	Monitoring frequency	Phase/ status	Budget in birr
	3. Adequate OHS personnel protective gear will be provided to the employees	Prepared document	Observation & document		During commissioning phase	Decommissioning phase	
	4. Trucks will be covered during the haulage of materials to reduce dust emissions	All OHS protective gear provided	Observation & document	WEPO	During commissioning phase	Decommissioning phase	
Socio-economy impact	8 Providing adequate provident funds or pensions to those who want to retire	Documented verification	Observation & document	……and WEPO	Commissioning phase	Decommissioning phase	
	9 For young workers, particularly the vulnerable groups, facilitating to be hired in similar positions commensurate with their skill, interest, and experience	Number of employees	Observation & document	Women affairs office	Commissioning phase	Decommissioning phase	
	Total monitoring cost						**5,895,000.00**

9.3 Construction Monitoring

Construction monitoring refers to the process of overseeing and supervising construction activities to ensure that they are carried out in accordance with the project plans, specifications, and applicable regulations. Construction monitoring is an important aspect of construction project management and is essential for ensuring that the project is completed on time, within budget, and to the required quality standards.

During the construction phase, the Wolayita Sodo town project office shall require contractors to comply with this ESMP and to recruit an environmental and occupational health and safety officer to effect the implementation of the ESMP. The contractor should have a designated environmental officer to oversee day-to-day project construction activities.

In addition, both the project and site managers should familiarize themselves with the ESMP so as to execute required environmental, health, and safety supervision roles. It is also preferable that the site engineer has to work by considering environmental issues related to the project. The project manager shall have the ultimate responsibility for the implementation of ESMP and will therefore ensure that resources are duly provided. The project manager shall be responsible and ensure staff are adequately inducted and trained at the site regarding environmental and social management including emergency procedures. The Contractor's site supervisors and foremen will ensure that the provisions in this ESMP are implemented within the sites under their supervision and collect and transmit relevant information to the environmental and occupational safety and health Officers.

9.4 Implementation Arrangement

Implementation of the project will use the existing institutional arrangement and working team found at WSTWSSE. At WSTWSSE there is an established position for an Environmental Officer and positions for sociologists, which will provide oversight on the implementation of the environment (ESIA) and social components of the program. The contractor and supervising consultant to comply with this ESMP and recruit OHS officers to implement and monitor to oversee day-to-day project construction activities and ESMP.

Both the project and site managers should familiarize themselves with the ESMP so as to execute required environmental, health, and safety supervision roles. The project manager shall have the ultimate responsibility for the implementation of ESMP and will therefore ensure that all of the resources are duly provided and ensure staff are adequately inducted and trained at the site regarding ESMP including emergency procedures. The Contractor's site supervisors and

foremen will ensure that the provisions in this ESMP are implemented within the sites under their supervision and collect and transmit relevant information to the environmental and occupational safety and health Officers.

During the construction phase of the project, the responsibility for implementing ESMP will be of the contractor, WSTWSSE, WST Bureau of Health, WST, and regional environmental authority. During the operation and maintenance of the FSTP works, the responsibility will be mainly under the WSTWSSE.

WSTWSSE has environmentalist and social safeguards but since the technology is new to the area and does not have sufficient experience and capability for dealing either with the implementation of environmental mitigation measures or monitoring of various environmental quality parameters. Hence experts and operators will require training and expert assistance to perform the ESMP environmental monitoring plan. The proposed training program for different staff with their field of training is given in table (25) below in addition to on-the-job training by the environmental consultants

Table 25 Training Programs for Capacity Building and associated costs

Target Group	Training title	Training content	Duration (Days)	Time	Trainer	Cost in birr
Top Management AMTWSSE/PMU monitoring Staff	Environmental management	Awareness of Environmental Management; Legal requirements; and National environmental standards	3	2X/year	WSTWSSE MoWE Environmental Consultant	600,000
AMTWSSE Staff, regional water and energy bureau), Health officers, EPA, and other relevant stakeholders	Environmental supervision, monitoring, and reporting	Public health and safety of FSTP management; Community participation in environmental supervision monitoring; Risk assessment, response, and control; Awareness creation	3	2X/year	WSTWSSE MoWE Environmental Consultant	350,000
On-site construction management staff; environmental and social safeguard staff; village /group authorities	Implementation of mitigation measures	Overview of environmental monitoring; Requirements of environmental monitoring; Role and responsibilities of contractors; monitoring forms and guide how to fill in the forms and risk report; Preparation and submission of reports; Grievance handling and reporting; GBV reporting	2-3	1x/year	WSTWSSE MoWE Environmental Consultant	500,000.
Representatives of community and/or worker leaders	Environmental sanitation and safety	Environmental and Social safeguards; Safety and health issues; Environmental Pollution risks and management; Mitigation measures at construction sites; Procedures to deal with emergency situations	2	2X/Year	WSTWSSE MoWE Environmental Consultant	200,000
Core Process Head, FS Emptying Customer Service Team Leader, Head of Finance	Customer service management	Marketing (promotion), customer handling; record keeping and reporting; financial management	3	2X/Year		300,000
Core Process head, FS Emptying Customer Service Team Leader, Sludge Truck Drivers Sludge Emptying Crew	Safety measures for proper FS emptying	Training on risks, safety measures, and good practices for FS sludge collection and conveyance	3	2X/Year	WSTWSSE MoWE Environmental Consultant	300,000
Core Process FSTP Team Leader FSTP operators	Operation and Maintenance Staff	Treatment plant operation principles; operation and maintenance procedures and treatment processes	3	2X/Year	WSTWSSE MoWE Environmental Consultant	350,000
Utility Director, Core Process head, FS Emptying Customer Service, Team Leader FSTP Finance Team	Leadership and communication	Training on group coordination, team leading, and Communication	3	2X/year	WSTWSSE MoWE Environmental Consultant	400,000
Total estimated cost						**3000000**

9.5 ESMP Implementation Costs

The above ES Management and Monitoring Plan tables summarized the main possible negative impacts, nature of the receiving environment, possible mitigation measures, expected outcomes, monitoring indicators, monitoring plan, responsible institution for monitoring, time duration, and cost estimations in Birr.

Even though it is very rough and subjective the overall ESMP cost estimated duringthe construction, operation, and decommissioning phase is about **17,154,500.00 (Seventeen Million One hundred fifty-four thousand five hundred) Birr.** This price estimation is not exhaustive due to the very wide nature of the study and market dynamics. Thus assuming the market dynamics and complexity of the study, the price estimation might have an error of **±30**% of the current value.

Table 26 Summary of Budget Estimate for ESMP

No.	Component	Project phase	Reference	Estimated cost in birr
1	ESMP	Throughout all phases	Table 22	6,700,000.00
2	Environmental and Social Monitoring	Throughout all phases	Table 23	**5,895,000.00**
3	Training and capacity building	Throughout all phases	Table 24	3,000,000.00
	Subtotal 1+2+3			15,595,000.00
	Contingency 10%			1,559,500.00
	Total			**17,154,500.00**

9.6 Reporting

Reporting is an important aspect of any construction project, as it provides a means of communicating progress, issues, and other key information to stakeholders.

During construction, concise monthly monitoring reports should be compiled by the contractor. The report will highlight the different activities undertaken to manage environmental and social aspects of the project in line with contract specifications, laws, standards, policies, and plans of Ethiopia and WB safeguard policies.

The report will be discussed during the monthly progress meetings among the WEPO, the project office, the contractor, and other concerned utility agencies as necessary. The Environmentalist and Social Specialist for the supervising engineer will approve the contractor's monthly environmental and social monitoring report which will then be transmitted to WEPO and the project office for final approval. The WEPO's Environmental Management and Social Specialist will also independently monitor the implementation of the ESMP and/or verify the accuracy and content of the contractor's monitoring report and then report to the project office. The report will also be shared with the WB and other relevant stakeholders. Approval of

the environmental monitoring report will be the basis for the supervising engineer to approve payment of the respective environmental and social bill of Quantity (BoQ) items.

During the operation phase monitoring mostly relies on WEPO and the project office for effective project execution. The role of the project office is both implementing and internal monitoring. The WEPO monitoring reports should be shared with the project office, and regional EPA for further remedial actions. Besides WEPO has a mandate, or order for the project office to hire a consultant, to conduct audit studies and disclose the findings to interested public bodies as a regulatory requirement (National EIA proclamation 299/.2000).

9.7 Environmental Audit

Environmental audits can provide a valuable tool for organizations to evaluate their environmental performance, identify opportunities for improvement, and demonstrate their commitment to sustainable development. Audits will be necessary both during construction and project operation. While construction audits will aim to verify compliance to impact mitigation requirements, post-construction audits are a regulatory requirement to ensure effects and compliance monitoring and the implementation of the mitigation measures within 12 months and not more than 24 months after the start of the operation of the FSTP. Both construction and post-construction audits can be conducted internally by the project office or by a Consultant hired by the project office with technical support from FSTP.

9.8 Grievance handling procedure

A grievance handling procedure is a process used by organizations to address and resolve complaints or grievances raised by employees or other stakeholders. The procedure typically outlines the steps that should be followed when a grievance is raised, including who should be involved in the process, how the grievance will be investigated, and the expected timeline for resolution.

This section describes the avenue for affected persons to lodge a complaint or express a grievance against the project, its staff, or contractors during project implementation. It also describes the procedures, roles, and responsibilities for addressing grievances and resolving disputes. Every aggrieved person shall be able to trigger this mechanism to quickly resolve their complaints.

The objectives of the grievance handling are to:

- Ensure that appropriate and mutually acceptable corrective actions are identified and implemented to address complaints;
- Verify that complaints are satisfied with outcomes of corrective actions;
- Avoid the need to resort to judicial proceedings.

The grievance mechanism at each project facility will be fed from four main sources:

- Project-affected persons(PAPs) or project affected Households (PAHs)
- Local community residents and the respective local leaders;
- Supervising engineer, clerk of works, or contractor; and
- Monitoring team who will forward issues/concerns identified in the field.

According to the RPF (2016), the grievance resolution committee is indicated in Table 27

Table 27 Grievance Resolution Committee

No	Institution/ individual representation	Role
1	Municipality representative	Chairperson
2	Community representative	Member
3	Representative of PAPs	Member
4	Women affairs	Member
5	Two respectable citizens from society including one from the underserved community, one of them should be women	Members
6	Representative of implementing agency	Secretory and member

Steps of the grievance process

Step One: *Receipt of complaint*

A verbal or written complaint from a complainant will be received by the Clerk of Works or Grievance Redness Committee and recorded in a complaints log s(he) keeps on-site. The log will indicate grievances, the date lodged, action taken to address the complaint or reasons the grievance was not acted on; information provided to the complainant, and the date the grievance was closed. Grievances should be lodged at any time, either directly to the Clerk of Works, Grievance Redness Committee (project office), or through the local council chairperson. The process for lodging a complaint is:

- Clerk of works on site or project office receives a complaint(s) from the complainant and records it in a log (in Amharic);
- The Clerk of Works or Grievance Redness Committee reads the recorded grievance for the complainant to confirm correct detail of the complaint has been documented;
- Both the complainant and clerk of work or Grievance Redness Committee sign the log to confirm grievance was accurately recorded.

Step Two: ***Determination of corrective action***

If in his/her view, a grievance can be solved at this stage, the Clerk of Works or Grievance Redness Committee will determine a corrective action in consultation with the aggrieved person. Remedial action(s) and time frame within which they must be accomplished have 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 5 days. 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 15 from lodging a grievance.

Step Three: Meeting with the complainant

The proposed remedial action and the timeframe in which it is to be implemented will be discussed with the complainant within 5 days of receipt of the grievance. Consent to proceed with the corrective action will be sought from the complainant and witnessed by a local government chairperson.

Step Four: Execution of Corrective Actions

Mutually agreed corrective action will be commenced by the project office 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 Five: Verification of the Remedial Actions

To verify satisfaction, the aggrieved group or person will be asked to return if not satisfied or bring the case to court with the corrective action.

Step SIX: Action by the project office and/or the contractor

If the project office or contractor cannot solve the grievance within 15 days, s(he) will refer it to court through the social safeguard and or occupational safety and health professional. It is believed that most of the possible grievances can be solved at this level

10. Conclusion and Recommendation

10.1 Conclusion

The second Urban Water Supply and Sanitation Program (UWSSP) aims at increasing access to enhanced water supply and sanitation services in cities and cities of Ethiopia. The project is intended to aid in the government's efforts to eliminate open defecation, raise the proportion of the population using a "safely managed" sanitation service, and improve current water supply services through increased operational effectiveness and expansion of water supply service to underserved areas.

The Federal Democratic Republic of Ethiopia's Water and Energy Minister hired Green Sober Environmental Consultant Pvt. Ltd. Co. to conduct an ESIA on the fecal sludge treatment plant (FSTP) and toilet (public and communal) construction for UWSSP-II in WST.

The development of the FSTP can contribute immensely to improving sanitation facilities, ending open defecation and breaking the chain of disease transmission, creating job opportunities for material or equipment suppliers, construction contractors, and other project-relevant professionals, and transferring new technology and knowledge to the city and the nation at large. The long-term environmental and social benefits include reduced morbidity and increased productivity of households; increased enrolment of children in educational institutions and improved tourist destination and economic development.

Taking the receiving environment into consideration, the ESIA study identified major negative impacts during construction and operation phases as follows; property damage, biodiversity disturbance, landscape and integrity change, water, air and noise pollution, social misdemeanor, and related others. The negative impacts can cause damage to the biological, physical, and social environment if they are not properly planned and managed as indicated in the mitigation measure or ESMP section of this report. The project office, the city municipality, and the contractor have a lion’s share role in the execution of the mitigation measures presented. The regulatory work, monitoring, and evaluation mostly rely on the WEPO and the WB in addition to the project office itself study and decision-making to minimize grievance and ensure tenable benefits from the project development.

In conclusion, if the FSTP operates in conformity with the legal requirements provided in the ESMP, the benefits of the project to the nation will be by far balancing its potential negative effects.

10.2 Recommendation

Generally, the ESIA illustrates that the benefits of the WST FSTP construction project are more important than the adverse effects. Adverse impacts identified can be mitigated through implementing the proposed management and monitoring plans to acceptable boundaries. Consequently, it is recommended to implement the project with firm observation of the environmental and social management and monitoring plans. However, the project management consultant formerly organized has to arrange a 'Construction Management Plan' before the commencement of construction works and this plan should be part of the contract.

Furthermore, the environmental management plans must be part of the contract documents of the contractor thus ESMP compliance is confirmed. The ESMP recommends environmental monitoring at the varied phases of the project. The monitoring should be accompanied to check the effectiveness of mitigation measures. Besides, the Environment and Safety unit must set an environmental checklist for the everyday environmental audit of the project accomplishments. Strict control and supervision of the contractor by the Ministry of Water and Energy in close collaboration with Wolayita Sodo EPA will ensure compliance with required mitigation measures.

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Appendix

Appendixes	Appendix title	Attached document
1	List of study Teams in charge of the ESIA	Appendix 1 Team in charge of the ESIA.zip
2	Public consultation meetings and engagement participants	Minutes of PC Wolaita Sodo.zip
3	Chance Find Procedure	Appendix 3 Chance Find Procedure.zip
4	List of consulted stakeholders	Lists of community consultation participants on the proposed FSTP construction WSodo.zip
5	Environmental Guidelines for Construction Contractors	Appendix 5 Environmental Guidelines for Construction Contractors AMT.zip
6	TOR	Appendix 6 TOR MOWE 2ND UWSSP.zip
7	Data collection tool	Appendix 7 Data collection tools.zip
8	Minute and list of tripartite discussion participants	Appendix 8 Minute on Triparty consultation W Sodo FSTP.zip