ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT REPORT

FOR THE PROPOSED YIRGA ALEM IAIP AND DILLA RTC

ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT

EASTERN SNNP REGION, ETHIOPIA

MARCH 2018

Report produced by:

Engineer Tequam Water Resources Development and Environment Consultancy (ETWRDEC)

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In collaboration with WSP/UNOPS

On behalf of:

UNIDO and SNNP Industrial Parks Development Corporation, Federal Democratic Republic of Ethiopia

ESIA REPORT

FOR THE PROPOSED YIRGA ALEM IAIP AND DILLA RTC

ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT

SNNP REGION, ETHIOPIA

SNNP Region IPDC

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TABLE OF CONTENTS

TABLES

FIGURES

APPENDICES

GLOSSARY

ACPZ	Agro Commodity Procurement Zones
AfDB	African Development Bank
AGP	Agricultural Growth Program
AQIA	Air Quality Impact Assessment
ASTM	American Society for Testing Materials
BDL	below the detection limit
CAPEX	Capital Expenditure
CITES	United Nations Convention on International Trade in Endangered Species
CO	Carbon Monoxide
CO_2	Carbon dioxide
CSA	Central Statistical Agency of Ethiopia
EEP	Ethiopian Electric Power
EHS	Environmental, Health and Safety
EIA	Ethiopian Environmental Impact Assessment
ESIA	Environmental and Social Impact Assessment
ELSR	Elevated Level Storage Reservoirs
ERA	Ethiopian Roads Authority
ESMP	Environmental And Social Management Plans
ESDPRP	Ethiopian Sustainable Development & Poverty Reduction Programme
ETWRDEC	Engineer Tequam Water Resources Development and Environment Consultancy
EU	European Union
EWCA	Ethiopian Wildlife Conservation Authority
FAO	Food and Agriculture Organization

FDRE	Federal Democratic Republic of Ethiopia
GDP	Gross Domestic Product
GHG	Green House Gases
GLSR	Ground Level Storage Reservoirs
GPS	Global Positioning System
GTP	Growth and Transformation Plans
GTP II	National Growth and Transformation Plan II
ha	Hectares
IAIP	Integrated Agro Industrial Parks
IDS	Industrial Development Strategy
IFC	International Finance Corporation
ILO	International Labour Organisation
IPCC	Intergovernmental Panel on Climate Change
IPDC	Industrial Parks Development Corporations
ISRIC	International Soil Reference and Information Centre
ISS	Integrated Safeguards System
IUCN	International Union for Conservation of Nature
IUSS	International Union of Soil Sciences
MACE	Mahindra Consulting Engineers
MAP	Mean Annual Precipitation
MoEFCC	Ministry of Environment, Forest and Climate Change
MoA	Ministry Of Agriculture and Natural Resources
MoI	Ministry Of Industry
MSW	Municipal Solid Waste
$Na–HCO_3$	Sodium Bicarbonate

NO_2	Nitrogen Dioxide
NOx	Oxides Of Nitrogen
PA	Protected Areas
PAP	Project Affected People
PM_{10} and $PM_{2.5}$	Particulate Matter
OPEX	Operational Expenditure
OS	Operating Safeguards
RAP	Resettlement Action Plan
RTC	Rural Transformation Centres
TDS	Total Dissolved Solids
ToR	Terms of Reference
SME	Small and Micro Enterprises
SO_2	Sulphur Dioxide
SNNP	Southern Nations, Nationalities and Peoples Region
STP	Sewage Treatment Plant
UN	United Nations
UNHCR	United Nations High Commissioner for Refugees
UNIDO	The United Nations Industrial Development Organisation
UNOPS	United Nations Office for Project Services
US	United States
USDA	United States Department of Agriculture
USEPA	United States Environmental Protection Agency
UTM	Universal Transverse Mercator
WBG	World Bank Group
WFB	Wonji Fault Belt

WMS	Welfare Monitoring Survey
WRB	World Reference Base Classification System
WSP	WSP Environment and Energy, Africa.

1 INTRODUCTION

1.1 BACKGROUND TO THE PROJECT

Ethiopia is located in the Horn of Africa and it is bordered by Eritrea to the north and northeast, Djibouti and Somalia to the east and southeast, Sudan and South Sudan to the west, and Kenya to the south. It is the second most populous country in Africa, with a population of 97 million people across a total area of 1.1 million square kilometres (km^2).

The country is divided into nine National Regional States and two city administrations. Each state is drawn along ethno-linguistic lines and is endowed with a degree of self–rule. Each state is headed by a state president which is elected by the state council. These states are further divided into 103 Zones (sub-regions), 800 Woredas (districts), and 15,000 Kebeles (the lowest administrative units). Each Regional State, including the Southern Nations, Nationalities and Peoples' Region (SNNP), has its own regional government.

Ethiopia has a federal system of government which was established in the early 1990s, in accordance with the Constitution of the Federal Democratic Republic of Ethiopia (FDRE). The national constitution pluralist political system and is headed by Dr Mulatu Teshome, President of the FDRE.

Agriculture is a key driver of Ethiopia's long-term growth and food security, contributing 46% of the country's Gross Domestic Product (GDP), and accounts for 90% of export value with approximately 83% of the population being dependent on agriculture for their livelihoods. Due to investments by the FDRE) and its development partners, the agriculture sector has seen consistent growth of over 8 to 10% per annum over the past decade. The FDRE is committed to supporting the development of the sector through designing, introducing and implementing relevant policies, strategies, and programs such as the Growth and Transformation Plans (GTP) and Agricultural Growth Program (AGP). In spite of consistent growth in the agricultural sector in recent years it has been identified that the sector is not yet performing to its optimum in terms of productivity, wealth creation, foreign exchange generation and food security.

The average land holdings in Ethiopia are noted to be between 0.2 and 0.5 hectares (ha), with the majority of these not being integrated into the commercial value chain for agricultural produce. Although food-processing industries are present in Ethiopia, they are currently restricted in their production by the availability of raw materials. The restriction on raw material input is related mainly to access, but also to the quality of the produce which results in inefficient handling chains, post-harvest losses and higher prices. Investment and development of the agro-industrial sector will in turn improve the economy by converting the agro-export from primary, unprocessed products to processed products, which will underpin economic growth for this sector and Ethiopia as a whole. The primary limitation to this proposed agro-industrial growth is the severe lack of infrastructure. The development of agro-industries presents Ethiopia with an opportunity to accelerate economic development and achieve its industrial development goals.

The FDRE committed to a five-year undertaking, as part of the first Growth and Transformation Plan (GTP I) to build the foundation to launch the Country from a predominantly agrarian economy into industrialisation. Among the sectors to which the second Growth and Transformation Plan (GTP II) gives emphasis is manufacturing and industrialisation to provide the basis for economic structural change; and a central element in this strategy for transforming the industry sector is development and expansion of industrial parks and villages around the country.

The development of Integrated Agro Industrial Parks (IAIPs) and accompanying Rural Transformation Centres (RTCs) forms part of the government-run Industrial Parks Development Corporations (IPDC) strategy to make Ethiopia's agricultural sector globally competitive. The concept is driven by a holistic approach to develop integrated Agro Commodity Procurement Zones (ACPZs) and IAIPs with state-of-the-art infrastructure with backward and forward linkages based on the Inclusive and Sustainable Industrial Development model. A total of 17 ACPZs have been identified (**Figure 1-1**).

The United Nations Industrial Development Organisation (UNIDO) in coordination with the FDRE, as represented by Ministry of Industry (MoI) and the Ministry of Agriculture and Natural Resources (MoA) are working in partnership to establish an appropriate platform for agro-industrial development, in the form of IAIPs, with the aim of transforming the agriculture sector. The concept of IAIPs is to integrate various value chain components via the cluster approach. Associated RTCs are to act as collection points for fresh farm feed and agricultural produce to be transported to the IAIPs where the processing, management, and distributing (including export) activities are to take place.

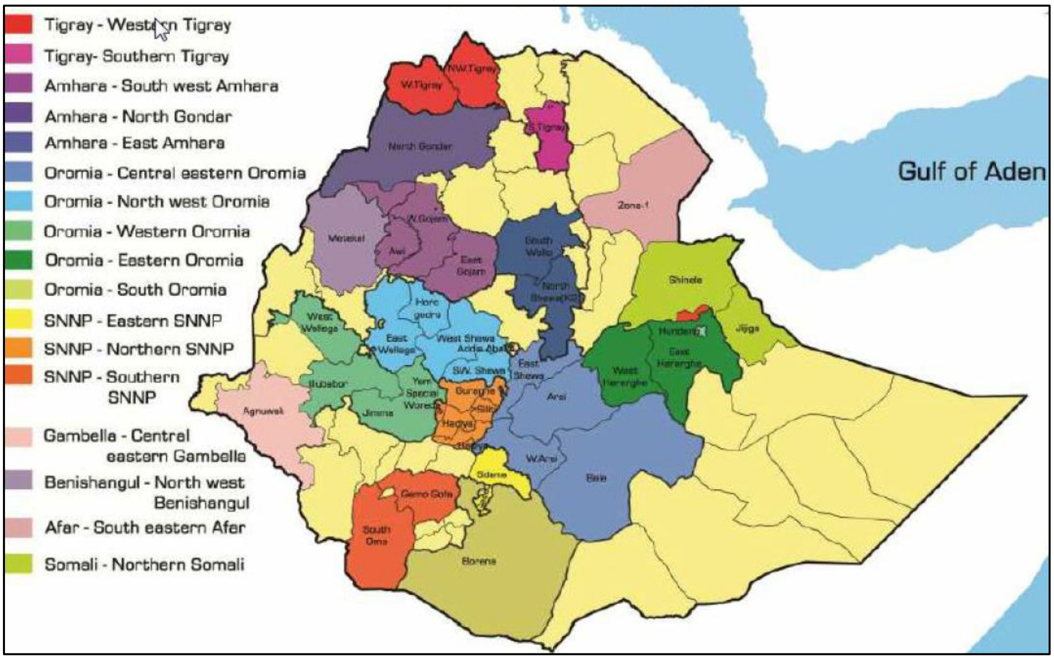

Figure 1-1: Potential Agro Commodities Processing Zones (Source: MACE)

Of the 17 ACPZs four have been selected for the establishment of pilot IAIP and RTC facilities (**Figure 1-2**). The four IAIPs and accompanying RTCs are to be established strategically across the country as a pilot phase. Based on the success of the four initial developments UNIDO and the FDRE will establish additional IAIPs and RTCs around the country. The United Nations Office for Project Services (UNOPS), on behalf of UNIDO and the FDRE, is facilitating the process to obtain the required environmental permissions for the proposed developments.

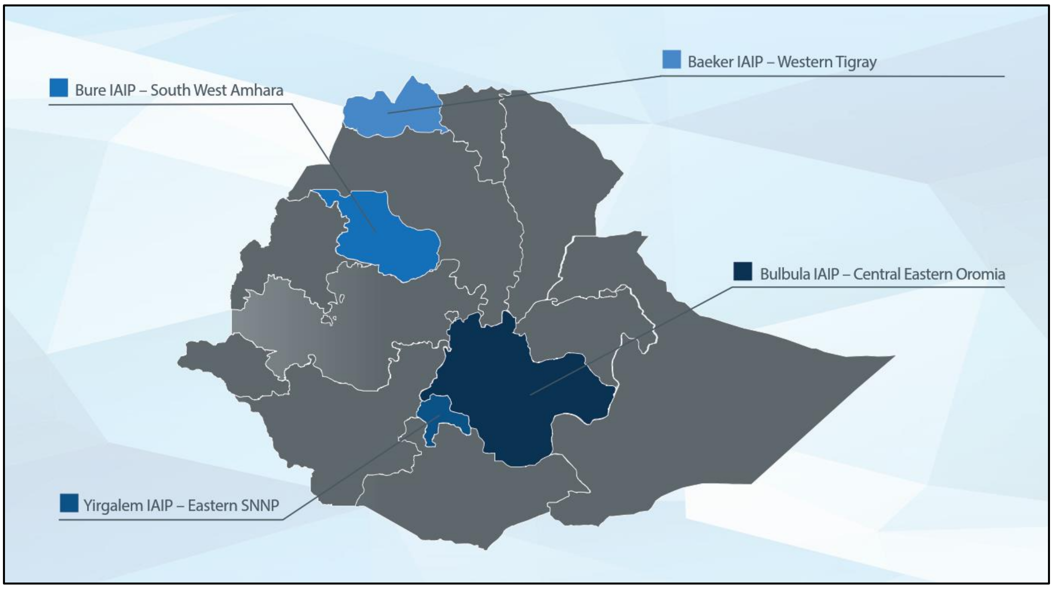

Figure 1-2: The four ACPZs selected for pilot facilities (Source: MACE)

This report relates to the Eastern SNNP ACPZ facilities as identified in **Table 1-1**.

Table 1-1: ACPZs selected and associated piloting facilities.

Region	IAIP	RTC
SNNP (Eastern SNNP)	Yirga Alem	Dilla

The proposed Yirga Alem IAIP site is located within the SNNP Region, which is one of the nine regional state members of the FDRE established by the 1995 constitution provisions. The site is situated in the Dale Woreda of the Sidama Administrative Zone of the SNNP Region. While the RTC site is situated in the Dilla Zuria Woreda of the Gedeo Administrative Zone.

The location of the Yirga Alem IAIP and Dilla RTC sites are indicated in **Figure 1-3**.

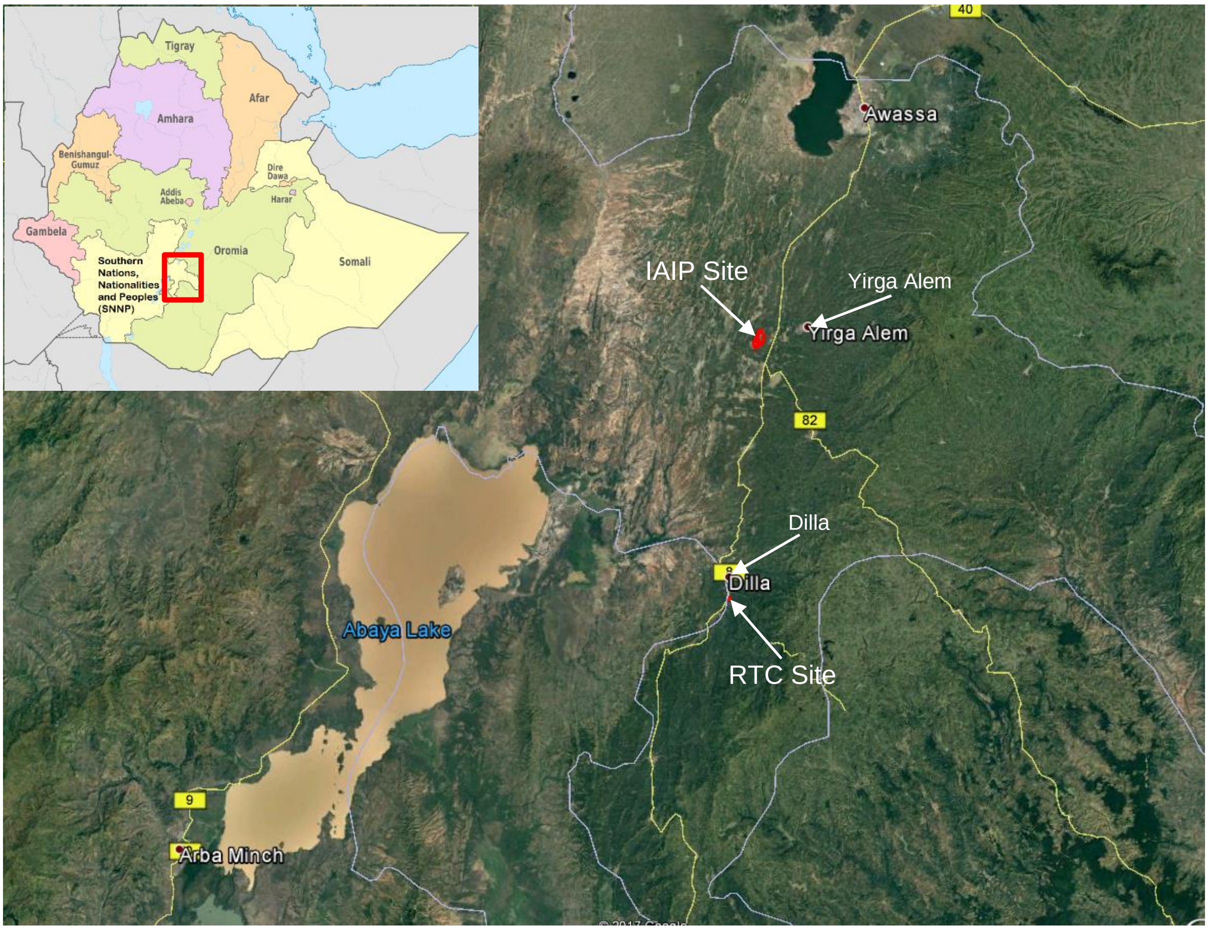

Figure 1-3: Layout showing the administrative map of the Regions and location of the Yirga Alem IAIP and Dilla RTC sites in SNNP.

Under the Ethiopian Environmental Impact Assessment (EIA) Proclamation (No. 299/2002), the proposed Project requires an EIA and authorisation by the Ministry of Environment, Forest and Climate Change (MoEFCC) before any construction activities may commence. Due to the potential for international project financing the Environmental and Social Impact Assessment (ESIA) will be undertaken in line with the Ethiopian Environmental Legislation as well as the African Development Bank (AfDB) Integrated Safeguards System (ISS).

The Ethiopian based environmental consultancy, Engineer Tequam Water Resources Development and Environment Consultancy (ETWRDEC), in collaboration with WSP, Environment & Energy, Africa, have been appointed to undertake the required ESIA for the proposed Yirga Alem IAIP and associated Dilla RTC within the Eastern SNNP Region (the Project) in order to obtain environmental certification.

An ESIA is conducted in order to identify and assess the likely environmental and social impacts of a proposed project, to determine their magnitude and significance, and to define management or mitigation measures designed to avoid and minimise where possible, or if not, to offset or compensate for adverse impacts and risks.

The development of the SNNP IAIP and the RTC will require ancillary infrastructure such as access roads, power lines, water pipelines and communication infrastructure in order to successfully implement the project. Ideally ancillary infrastructures would be captured as part of the development project and assessed within this ESIA. However, at this stage of the proposed Project, the routing of all linear infrastructure, including access roads, power lines, water pipelines and communication infrastructure to the sites have not yet been finalised. Therefore, this ancillary infrastructure will need to be considered under separate environmental and social studies by the third parties establishing this infrastructure.

1.2 LAND TENURE AND LAND USE

In Ethiopia all land belongs to the State; whilst land can be leased to private individuals, they cannot own it. The Constitution provides for equal access, use, transfer and administration over land. It grants access to agricultural land for rural residents, and allows all inhabitants to utilise the land for farming. Farmers and pastoralists could be granted lifetime ‘holding rights’ giving them rights to farm the land except for its sale and mortgage.

All land in Ethiopia is considered public property. Ownership of land is now vested in the State and Ethiopian citizens have only a usufruct right over the land. The 1995 Constitution, Article 40(1), 40(2), 40(4), 40(5) and 40(7), includes legal frameworks that protect citizen’s rights to private property and sets conditions for expropriation of such property for state or public interests. The Constitution states that every citizen shall retain full right to immovable property built on the land and to improvements s/he brings about on the land by her or his labour or capital.

Hence, the State owns all land, but citizens have a usage right and full ownership of developments and improvements built on state land. This includes the right to alienate developments, to remove them or claim compensation for expropriation of property. Article 44 of the Constitution reiterates the right of displaced persons to financial or alternative means of compensation including relocation with adequate state assistance. Based on the framework provided by the Constitution, three Proclamations were issued: 1) Expropriation of Land Holdings for Public Purposes and Payment of Compensation Proclamation 2) Rural Land Use and Land Administration and 3) Land Lease Proclamation.

Land is state property in Ethiopia and citizens have user rights. Inheritance of user rights is allowed, but land use rights may not be mortgaged, however; structures developed on the land can be mortgaged. In the SNNP region, land usage certificates that belong to married couples typically record both the name of the husband and wife, giving equal rights to the wife. However, this depends on communities, as some local communities practice polygamy in the SNNP Region, and in such families the names of the husband and his first wife are often recorded in the land certificate (USAID report on Ethiopia, 2013).

The SNNP Region has arable highlands (*dega*), midlands (*woinadega*) and lowlands (*kolla*), and pastoral rangelands (*bereha*). The region covers the relatively fertile and humid midlands where the rural population of Ethiopia is concentrated. **Table 1-2** provides a breakdown of land uses in the SNNP Region (Girma and Hassan, 2014).

Table 1-2: Regional data - Land Use and Land Cover type

Land Use and Land Cover type	Spatial Coverage in	
	Area (000 ha)	%
Forest	638.43	5.9
High woodland	548.48	5.1
Plantation	237.20	2.2
Low woodland and shrubland	1 349.43	12.6

Land Use and Land Cover type	Spatial Coverage in Area (000 ha)	%
Other land	7 780.76	72.7
Water	152.86	1.4
Total	**10 707.16**	**100**

1.3 PURPOSE OF THIS REPORT (ESIA REPORT)

The fundamental objective of an ESIA is to ensure that the proposed development is environmentally sound and socially acceptable, and hence contributes to the development of environmental and social functions of local communities. It is also expected to provide a means whereby the overall environmental performance and social benefits of the project can be enhanced. This ESIA has been prepared to fulfil the requirements of the African Development Bank and the Ethiopian Environmental Impact Assessment Proclamation (299/2002) (the 'EIA Regulations').

The objective of the ESIA phase is to undertake an assessment of those potential impacts likely to result in significant effects, identified through the scoping phase. The Scoping Phase was conducted in November 2017 and determined the Terms of Reference for the ESIA. The ESIA:

- Meets the requirements of the Ethiopian EIA regulations;
- Meets the requirements of the AfDB Operating safeguards;
- Provides input into the Project Engineering Team to ensure that the design minimises environmental and socioeconomic impacts and maximises sustainability opportunities wherever possible;
- Identifies cross-cutting issues and coordinate mitigation measures across topics to be incorporated in an Environmental and Social Management Plan (ESMP); and
- Incorporates stakeholders through the ESIA process in accordance with the AfDB stakeholder engagement requirements.

In line with the AFDB requirements a Relocation Action Plan (RAP) has been developed and issued as a separate document associated with the ESIA report.

1.4 STRUCTURE OF THIS REPORT

The structure of this report is as presented in **Table 1-3** below.

Table 1-3: Structure of the ESIA Report

Chapter	Contents	AfDB Requirements
Chapter 1 – Introduction	Presents a brief background to the proposed Project, the ESIA process and the purpose and structure of the report.	Identify the project and the key role players.
Chapter 2 – Project Description	Provides a basic description of the Project area and the proposed Project components.	Define the project and identify potential sources of impacts. Describe features, locations and activities of project. Identify interactions between project and resources. Convey what is being proposed. (2015)

Chapter	Contents	AfDB Requirements
Chapter 3 – Need and Desirability	Describes the need and desirability and motivates the rationale for the proposed Project.	
Chapter 4 – Project Alternatives	Details the level of information provided regarding Project alternatives that have been considered thus far.	Identify and compare alternatives. Balance economic, technical, environmental and social factors. Look at merits and disadvantages of each alternative. (2015)
Chapter 5 – Policy, Legal and Administrative Framework	Provides an outline of the legislative, policy and administrative requirements, as well as international best practise applicable to the proposed Project.	The assessment complies with the relevant legislation and standards applicable in the local jurisdiction and the Bank. Takes into account national and regional standards. The Bank assesses the institution's requirements, which needs to be equivalent to the AfDB's requirements. (OS1; 2013)
Chapter 6 – The ESIA Methodology	Provides a brief overview of the ESIA process to be followed for the proposed Project.	Conducted to the principles of proportionality and adaptive management. The level of assessment and management must be proportional to the level of risk associated with the project. This assessment leads to the development of an ESMP. (OS1; 2013) Apply an 'interactions matrix' to identify possible interactions between project components and resources/receptors. (2015)
Chapter 7 – Stakeholder Engagement	Provides a brief overview of the stakeholder engagement process required.	Capture perspective of vulnerable individuals or groups. Stakeholder engagement activities carried out throughout the ESIA process. Demonstrate links between stakeholder feedback and ESIA element. Confirm and verify stakeholder engagement activities. (2015)

Chapter	Contents	AfDB Requirements
Chapter 8 – Baseline of the Receiving Environment	Provides a summary of the site investigations undertaken and findings thereof. This has addressed the following technical topics: – Climate; – Topography and Geomorphology; – Geology; – Soils; – Surface Water (Hydrology); – Groundwater (Hydrogeology); – Wetlands; – Air Quality; – Noise; – Transport / Access; – Waste Management; – Visual; – Biodiversity; and – Socio-economic.	Assess potential impacts on: geology, soils, surface and groundwater resources, air resources and climate, noise and vibration, ecosystems, socioeconomic and cultural. (OS1, 2013) Ensure flows, water ecological functions and the integrity of river systems and wetlands are maintained. Assess potential risks and impacts on biological diversity and ecosystem services. Categorise habitats into Natural Habitats, Modified Habitats and Critical Habitats. Identify invasive alien species and take precautions to avoid the introduction or spreading of the species. Detailed evaluation of climate change risks and adaptation measures (Category 1) or review climate change risks and adaptation measures (Category 2); assess climate change vulnerability. (2013) Comply with national regulations in legally protected areas and internationally recognised areas. (OS3, 2013)
Chapter 9 - Identification of Potential Impacts	Description and assessment of physical, natural and socio-economic environment environmental and social impacts that have been identified.	Identify potential interactions between the project and the physical, biological, cultural or human environment. Identify risks associated with cumulative impacts. Determine characteristics and magnitude of impacts. (2015)
Chapter 10 – Cumulative Impacts	Description and assessment of cumulative impacts that have been identified.	Determine the size of the area around the project that should be assessed and how to practically assess complex interactions. Consider the degree to which the project will contribute to possible cumulative impacts. (2015).

Chapter	Contents	AfDB Requirements
Chapter 11 – Environmental and Social Management Plan	Presents the action plan for the management of impacts throughout the construction and operation of the proposed project.	Identify measures to avoid, minimise and mitigate. Follow a mitigation hierarchy which is in line with any relevant Bank Requirements. The hierarchy is as follows: - Avoid at Source or Reduce at Source - Abate on Site - Abate at Receptor - Repair on Remedy - Compensate - Offset (2015) Compensation and offsetting is a last resort (OS1; 2013). Define basic management and monitoring measures to ensure impacts remain in conformance with predictions and mitigation measures effectively address impacts. Define roles and responsibilities, measures for information disclosure, grievance redress mechanism and process for confined consultation. (GN1.4)
Chapter 12 – Conclusions	Concludes the ESIA Report.	

1.5 DETAILS OF THE ESIA PROJECT TEAM

The MEFCC requires that an ESIA study of this type utilises a multidisciplinary team composed of a team of experts to undertake ESIA study. A list of the members of the Project team for the ESIA is provided in **Table 1-4**. As far as possible specialist studies were undertaken by ETWRDEC which is a Level 1 local Ethiopian Consultancy firm licensed with the MEFCC. Full certificates of competency for each specialist as well and the MEFCC certificate for ETWRDEC are provided (see **Appendix A**). International ESIA experience and supplementary specialist expertise was provided by WSP Environment and Energy, Africa.

Table 1-4: ESIA Project Team

Technical Area	Expert	Level of Competency	Reference No.
Policy, Law and Institutional Analyst	Mr. Imru Tamrat Yigezu	Consultant	11/1-1/2774
Sociologist	Mr. Girma Demisie Tefera	Senior Consultant	11/1-1/6592
Environmental Health	Mr. Abiyot Yismaw Gete	Consultant	11/1-1/6887
Land Use	Mr. Wosen Gultie Gebrekidan	Senior Consultant	11/1-1/6793
Biodiversity	Mr. Kahsae Ghebretensae Asgedom	Senior Consultant	11/1-1/1422/10

Technical Area	Expert	Level of Competency	Reference No.
Water Resource Management	Mr. Getachew Abrha Tesfamariam	Senior Consultant	11/1-1/1609/10
Environmental Engineer	Mr. Tequam Tesfamariam	Senior Consultant	11/1-1/6560
Waste Management	Mr. Addisu Gebremedhin Atshiba	Senior Consultant	11/1-1/6457

Each of the above experts are licensed with the MEFCC. A copy of each of the above experts Certificate of Competency issued by the MEFCC is attached in **Appendix A.**

1.6 DETAILS OF THE APPLICANT AND ENVIRONMENTAL ASSESSMENT PRACTITIONER

Any comments on the ESIA Report should be provided to the applicant, as well as the environmental assessment practitioner, as per the details provided in **Table 1-5** and **Table 1-6** respectively.

Table 1-5: Detail of the Applicant

Item	Detail
Name of Applicant	SNNP Region IPDC
Responsible Person	Biru Welde
Telephone	0930108367
E-mail	Biruwolde2@gmail.com

Table 1-6: Detail of the Environmental Assessment Practitioner

Item	Detail
Name of Firm	Engineer Tequam Water Resource Development and Environment Consultancy
Certificate of Competence	Environmental Impact Assessment Studies as a Consulting Firm in Level 1 Reference Number: 11/1.1/6883 Date: 27/4/2017
Responsible Person	Mr. Tequam Tesfamariam
Postal Address	P O Box 23849 Addis Ababa Ethiopia
Telephone	+251 911675791
E-mail	tequam1955@yahoo.com

1.7 ASSUMPTIONS AND LIMITATIONS

The following assumptions and limitations have been made/identified during the assessment process and in the compilation of this ESIA Report:

- The information provided by all parties is assumed to be accurate;
- The competent authority would not require additional specialist input, as per the proposals made in this report, in order to make a decision regarding the application.

2 PROJECT DESCRIPTION

This Chapter provides a description of the proposed Project, which entails the Yirga Alem IAIP and Dilla RTC facilities, and associated phases.

2.1 YIRGA ALEM IAIP

2.1.1 LOCATION

The proposed Yirga Alem IAIP is located approximately 5 km to the southwest of the town of Yirga Alem in the Eastern SNNP Region, and approximately 1.5 km from the federal highway no. 8 which runs through the town of Aposto (**Figure 2-1**). The site is situated approximately 318 km from the capital city, Addis Ababa. Awassa is located approximately 45kms north of the site and Dilla approximately 52 km to the south. The location of the site affords it the opportunity to utilise the developed social infrastructure in terms of banking, financial, recreational and logistics support in the area. The site is geographically located between 742986.866 N to 745714.474 N, and 427277.856 E to 428892.869 E (UTM Coordinates) in the Sidama Zone and falls under the jurisdiction of Yirga Alem town.

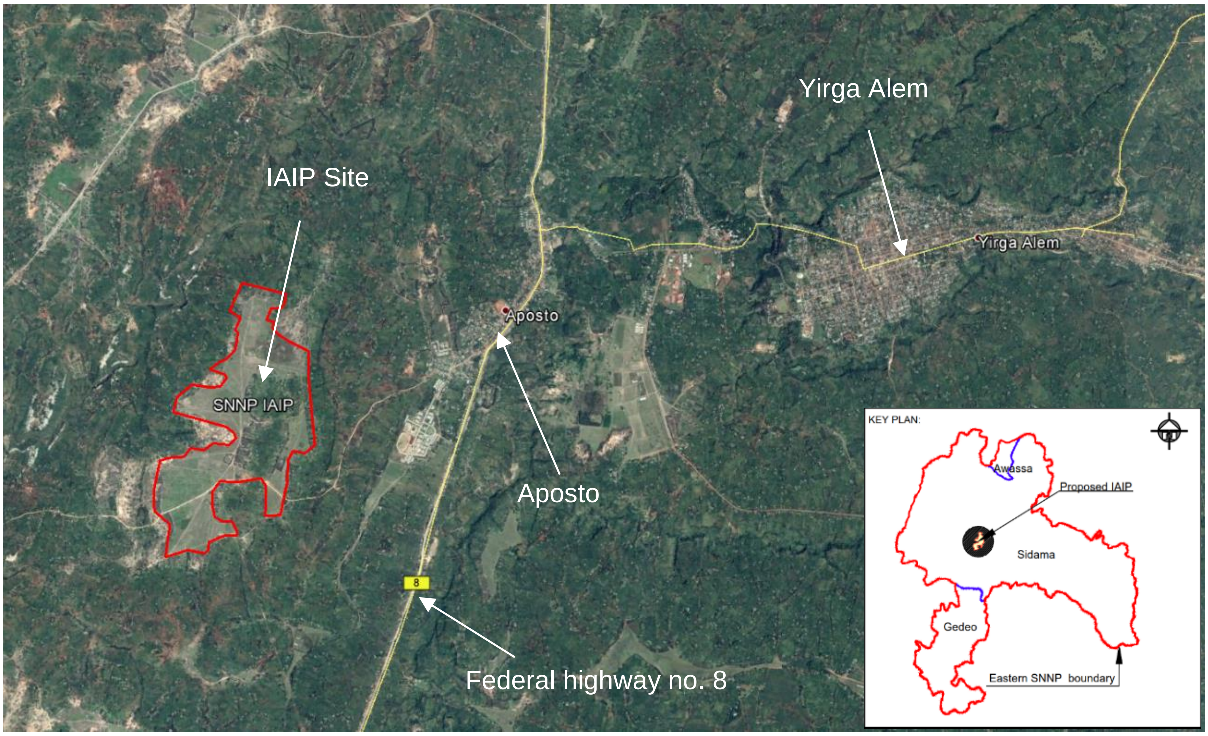

Figure 2-1: Yirga Alem IAIP, SNNP Region (Google Earth Image)

The proposed Yirga Alem IAIP is 214.86 hectares (ha) in extent. The IAIP is anticipated to be a pilot facility with the intended extent of development to ultimately reach a total 1,000 ha. Based on the success of the project the IAIP will ultimately be expanded within the remainder of the earmarked land. Note, this report only pertains to the assessment of the 214.86 ha pilot development. Future expansion of the IAIP will require separate environmental and social assessments to be undertaken.

The growing area to be serviced by the IAIP is approximately 163,461 ha with the main farming activities in the area consisting of cereals, coffee, fruits and vegetables, dairy and meat and other animal products. The predominant land uses on the site include farming (pastoral, crops and forestry) and residential activities.

Large portions of the site consist of open grassland used for grazing with portions of the land containing dwellings and associated crops farming practices and plantations, predominantly *Eucalyptus*. There is an existing medical facility, school, agricultural training facility and agriculture cooperative facility situated on the proposed site.

Figure 2-2 shows the layout of the IAIP boundary. The coordinates of the IAIP area are provided in **Table 2-1**.

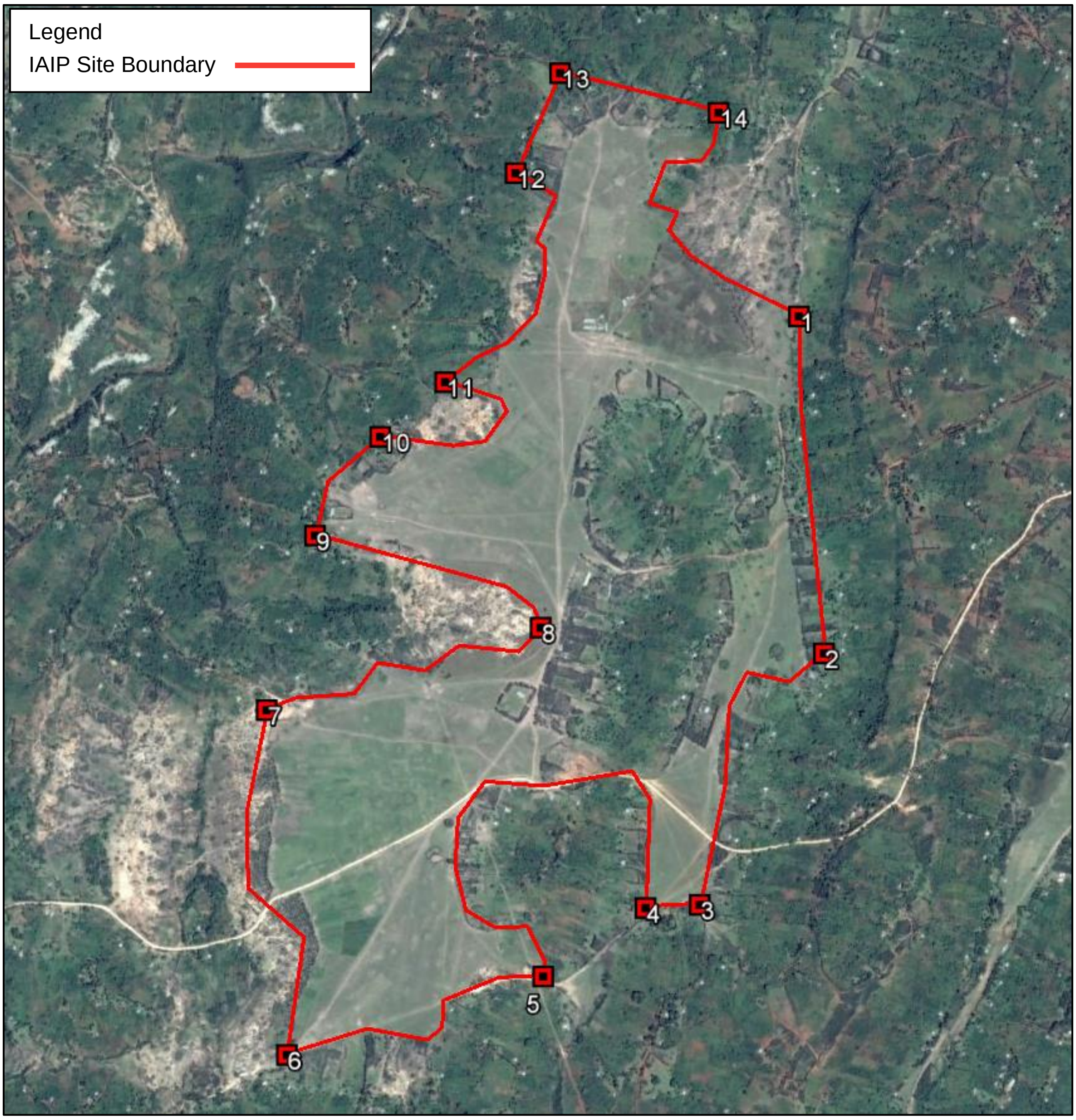

Figure 2-2: Layout showing the boundary of the IAIP area.

Table 2-1: Coordinates of the Yirga Alem IAIP area

Point	Easting (m)	Northing (m)
1	428826.40	745034.67
2	428892.87	744099.21
3	428545.80	743403.36
4	428394.63	743394.50

Point	Easting (m)	Northing (m)
5	428108.77	743204.59
6	427392.44	742986.87
7	427336.22	743943.32
8	428103.16	744171.73
9	427472.07	744427.65
10	427655.12	744701.67
11	427836.72	744853.39
12	428034.05	745435.49
13	428159.23	745714.47
14	428603.22	745602.85

Note: Coordinates are given in geographic format, zone 37, hemisphere N of the Adindan, Ethiopia datum (Ellipsoid: Clarke 1880)

2.1.2 SURROUNDING AREA

The area surrounding the IAIP site consists of households, settlements and associated support infrastructure such as roads and electrical power lines as well as agricultural land including open grassland for grazing, crop production and plantations (predominantly *Eucalyptus*). Furthermore the area includes mixed vegetation as well as the Gidabo River and large areas of barren land mainly associated with erosion. **Table 2-2** provides a rough breakdown of the various land use patterns identified within a 5 km radius of the IAIP site as indicated in **Figure 2-3**.

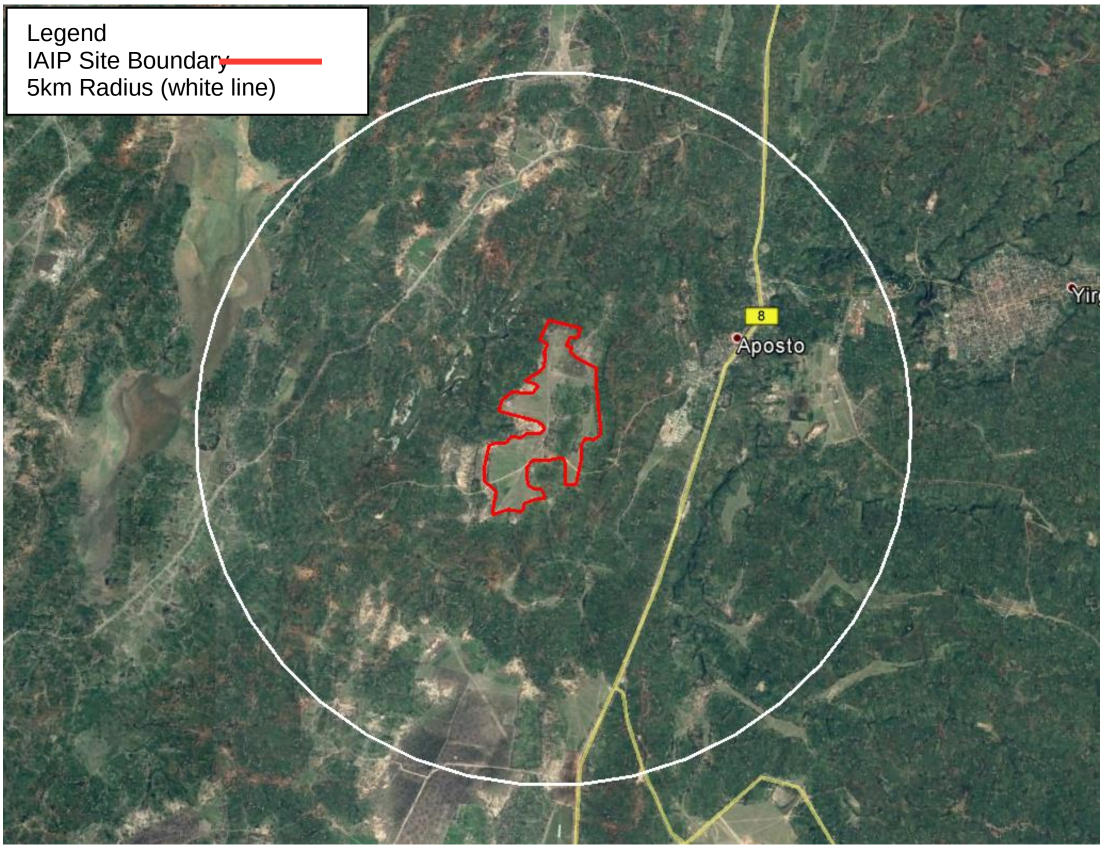

Figure 2-3: Image showing a 5km radius from the IAIP site.

Table 2-2: Land use pattern in the adjoining area – 5 kms radius

Land use classification	Spatial Coverage in	
	Hectares (ha)	Percentage (%)
Water body	40.00	0.51%
Agriculture	2074.15	26.42%
Mixed vegetation	4980.40	63.44%
Settlements	561.23	7.15%
Barren land	159.60	2.03%
Roads	34.62	0.44%
Total	**7850.00**	**100.00%**

2.1.3 DESCRIPTION OF THE PROPOSED YIRGA ALEM IAIP, SNNP REGION

The 214.86 ha IAIP comprises a processing area of 195.68 ha and a non-processing area of 19.18 ha. Most residents in the region are subsistence farmers with practices including the rearing of cattle as well as growing several crop types, however coffee is the most popular agricultural product in the zone. The IAIP designed to focus to focus on processing coffee along with vegetable and fruits, livestock, cereals, poultry and honey.

The IAIP includes the associated infrastructure required to effectively process all the materials. These include water and electrical supply infrastructure, sewage treatment works, roads and storage areas and the like. Quality control and assurance facilities are also included within the park along with support and training facilities. The non-processing area of the site includes a residential area as well as supporting facilities such as a school, crèche, place of worship and health clinic. The park also includes greenery and open spaces making up approximately 15% of the total area. **Figure 2-4** provides a layout of the proposed master plan of the Yirga Alem IAIP.

Figure 2-4: Master Plan (Source MACE Master Plan)

Table 2-3 provides an indication of the raw material and growing area required for the effective operation of the IAIP according to the design process.

Table 2-3: IAIP operational requirements

Item	Quantity
Raw Materials Required	387,305 MTPA
Growing Area Required	163,461 hectares

The preliminary details of the proposed Yirga Alem IAIP are summarised **Table 2-4** below.

Table 2-4: Summary of preliminary details of the Yirga Alem IAIP

SNNP – Eastern SNNP – Yirga Alem IAIP		
Location of IAIP		Yirga Alem in Sidama Administrative zone
Size of IAIP		214.86 hectares considered for initial development
RTC locations		**Dilla**, Yirgachefe, Bule, Daye, Aletawondo and Morocho.
Agricultural potential and agri-facilities		Cereals, coffee, fruits and vegetables, dairy and meat and other animal products
External infrastructure	*Energy*	Substation at Yirga Alem town at a distance of approximately 6 km
	Water	12 bore wells, with a 300 mm diameter and depth of 150 m
	Road network	The site abuts federal highway connecting Addis Ababa & Hawassa
	Railways, dry port, airport terminals	Bole International airport – 318 km and Hawassa airport – 50 km
	Telecommunication	Communication facilities available in Yirga Alem town can be extended
IAIP internal infrastructure details	*Total processing area*	195.67 hectares
	Total non-processing area	19.18 hectares
	Total area	214.85 hectares
	Length of road	10.205 km
	Total average water demand	3,920 m^3/day
	Wastewater generation	3,202.06 m^3/day
	Municipal Solid Waste generation	5.029 TPD
	Power demand	38.10 MVA

Source: UNIDO, Integrated Agro-Industrial Parks in Ethiopia, 2016

2.1.4 PROCESS UTILITIES

WATER REQUIREMENTS

During the design process it has been established that there is no existing water supply network available in the vicinity of the site. It was noted that the Gidabo River flows parallel to the site in close proximity, approximately 500 m, of the western boundary. Discussions with the authorities were undertaken by MACE whereby it was identified that there is no possibility for withdrawing water from

the Gidabo River due to the dependency of farmers in the lower areas on the river feeding the downstream agricultural areas. Furthermore, it was determined that the costs associated with the continuous electrical consumption required to pump the water to the site was economically not viable.

Water supply to the area is currently provided through a network of bore wells sunk in and around the town of Yirga Alem. During discussions with authorities, undertaken by MACE, it was identified that there is no surplus water available from this existing scheme to supply the IAIP. It is proposed that 12 bore wells, with a 300 mm diameter and depth of 150 m, be installed in the proposed site (or nearby depending on the yield of the bore wells). The estimated average daily water demand for the IAIP was calculated by MACE, including potable[1] and non-potable[2] water requirements (**Table 2-5**).

Table 2-5: Estimated average daily water demand for the IAIP

Land Use	Potable (m^3/day)	Non-potable (m^3/day)	Total (m^3/day)
Processing areas	3150	489	3639
Non-processing area	178	103	281
Total daily water demand	**3328**	**592**	**3920**

The proposed bore wells are to be installed in a phased manner so as to meet the required water demand at the various phases of the development. **Table 2-6** provides the anticipated water demand on a yearly basis, for the eight years from commencement of the IAIPs, showing the annual increase in water demand.

Table 2-6: Anticipated water demand per year for the period 2018 to 2026

Year	2018	2019	2020	2021	2022	2023	2024	2025	2026
Volume (m^3/day)	390	780.06	1462.53	1885	2470.04	2860.08	3153	3327.6	3328

To facilitate the adequate supply of water to the IAIP suitable water storage structures in the form of:

- One ground level storage reservoirs (GLSR) with a capacity of 5000 m^3 for the storage of potable water;
- Two elevated level storage reservoirs (ELSR) with a staging height of 16 m and storage capacities of 400 m^3 and 200 m^3 for the storage of potable and non-potable water respectively; and
- One underground sump (UGS), with a storage capacity of 1250 m^3, for the storage of treated water (i.e. non-potable water) from the sewage treatment plant.

A pump house and water treatment plant, are to be established within the IAIP to facilitate receiving raw water, treating the water, collecting and storing the treated water in the GLSR and ELSR for further distribution. An area of 1.71 ha is earmarked for the construction of the water treatment plant, GLSR and ELSR and pump house within the central portion of the IAIP. The design also includes a 'summer storage tank' for the capturing and storage of summer rainfall for use in the IAIP.

A suitable water treatment plant is to be established to treat the water supply in order to meet the acceptable limits of water quality as per Ethiopian drinking water standards.

WASTE WATER

A sewage treatment plant (STP) and common effluent treatment plant (CETP) are to be established within the south-eastern portion of the IAIP with a second STP located in the northern portion of the site. It is anticipated that wastewater generated by processing activities will be recycled. Furthermore,

[1] Potable water is to be used for drinking and sanitary needs and washing vessels. A potable water system will be put in place that will meet regulatory requirements in terms of quality.
[2] Non-potable water considered to be used for gardening, cleaning, cooling and toilet flushing.

sanitary wastewater from toilets and urinals shall be collected in an underground sewer system that is to be constructed as part of the processing plant's sanitary facilities. A self-contained treatment system is to be put in place to treat sanitary water.

Treated waste water is to be re-used in the production process as non-potable water. The estimated volume of sewage[3] to be generated by the IAIP during operations is shown in **Table 2-7**.

Table 2-7: Estimated average daily waste water generation for the IAIP

Processing and Non-processing areas	Quantity
Total	2042.50 m^3/day

SOLID WASTE

The estimated volume of municipal solid waste (MSW) to be generated by the IAIP during operations is shown in **Table 2-8**. Waste minimisation, recycling and treatment processes shall be included in the IAIP facility operational requirements.

Table 2-8: Estimated average daily solid waste generation for the IAIP

Processing and Non-processing areas	Quantity
Total	5.029 tpd

ELECTRICITY

The total power demand for the IAIP during operation is anticipated to be 38.10 MVA as indicated in **Table 2-9**. The total power demand is to be sourced from Ethiopian Electric Power (EEP) via the existing Yirga Alem substation, located approximately 6 km north-west from the proposed IAIP, and a second 400 kV Yirga Alem substation (currently under construction), located approximately 6 km southeast of the site.

Table 2-9: Estimated power demand for the IAIP

Processing and Non-processing areas	Quantity
Total	38.10 MVA

2.1.5 ANCILLARY INFRASTRUCTURE

This Section provides a brief summary of the proposed ancillary infrastructure within the IAIP.

FUEL (DIESEL/PETROL) STORAGE

The IAIP includes a truck lay bay, weigh bridge and fuel station. The storage of fuel will therefore take place on site.

TRANSPORT ROUTES AND ACCESS TO SITE

The proposed IAIP site is situated approximately 1.5 km west of the federal highway no. 8 (aerial route) connecting Addis Ababa and Awassa. The site is currently accessed via the existing gravel road extending approximately 3 km from the highway. No specific infrastructure intervention is proposed regarding transportation routes and access roads.

The site has no connectivity by railway and the nearest airports are Addis Ababa and Awassa which are 320 km and 60 km from the site respectively. The Dilla RTC is located approximately 52 km south

[3] Total sewage quantity includes effluent, sewage and sullage.

of the IAIP. All internal roads will be constructed and maintained by the IPDC while the FDRE is responsible for maintenance of the roads outside of the IAIP.

ELECTRICAL OVERHEAD TRANSMISSION LINES

It is proposed that a 33 kV and a 132 kV power transmission line are established. The transmission lines are to extend from the two substations located in Yirga Alem, which are connected to the national grid, to a substation to be established on site.

COMMUNICATION FACILITIES

Communication facilities available in the town of Yirga Alem are to be extended to the site.

2.2 DILLA RTC, EASTERN SNNP REGION

2.2.1 LOCATION

The proposed Dilla RTC site is located approximately 4 km south of the town of Dilla (**Figure 2-5**) and approximately 52 km south of the Yirga Alem IAIP. The proposed site falls under the jurisdiction of Dilla town, in the Dillazuria Woreda which is located in the Gedeo Zone of the Eastern SNNP Region.

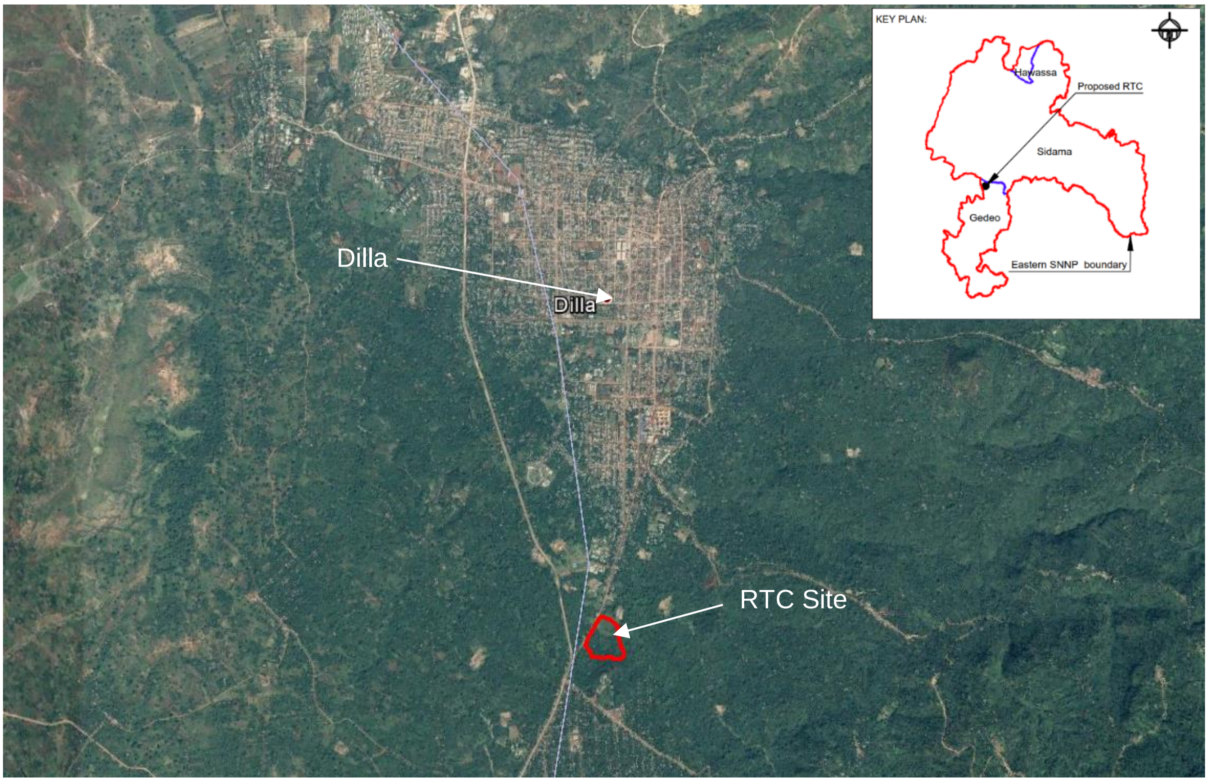

Figure 2-5: Location of the Dilla RTC in relation to Dilla Town, SNNP Region

The proposed RTC is located adjacent to the federal highway no.8 (Shashamane to Hagere Mariam) which is part of the Cairo-Cape Town Trans-African Highway 4. The site is geographically located between 704923.960 N to 705329.760 N and 423299.970 E to 423675.270 E (UTM Coordinates). **Figure 2-6** shows the layout of the RTC boundary. The coordinates of the Dilla RTC area are provided in **Table 2-10**.

Table 2-10: Coordinates of the Dilla RTC area

Point	Easting (m)	Northing (m)
1	423446.37	705329.76
2	423618.87	705233.66
3	423651.87	704931.86
4	423363.87	704939.56
5	423299.97	705050.46

Coordinates are given in geographic format, zone 37, hemisphere N of the Adindan, Ethiopia datum (Ellipsoid: Clarke 1880)

Figure 2-6: Layout showing the boundary of the Dilla RTC site

2.2.2 SURROUNDING AREA

The site abuts the federal highway no. 8, along the western boundary. The site is located just south of the edge of Dilla, and is surrounded by agricultural land, low to medium density residential areas. Associated support infrastructure, such as roads and electrical power lines, run adjacent to the site as well as north and south toward Dilla and Gwangwa respectively (**Figure 2-7**). The area includes agricultural land consisting or open grassland for grazing, integrated crop production and plantations (predominantly *Eucalyptus*) as well as natural vegetated areas.

The area around the site is densely vegetated however mostly consists of various types of agricultural crops including coffee, avocados, mangoes, bananas and pineapples amongst others. There is a higher concentration of residential dwellings adjacent to the highway however dwellings are scattered in the area surrounding the site.

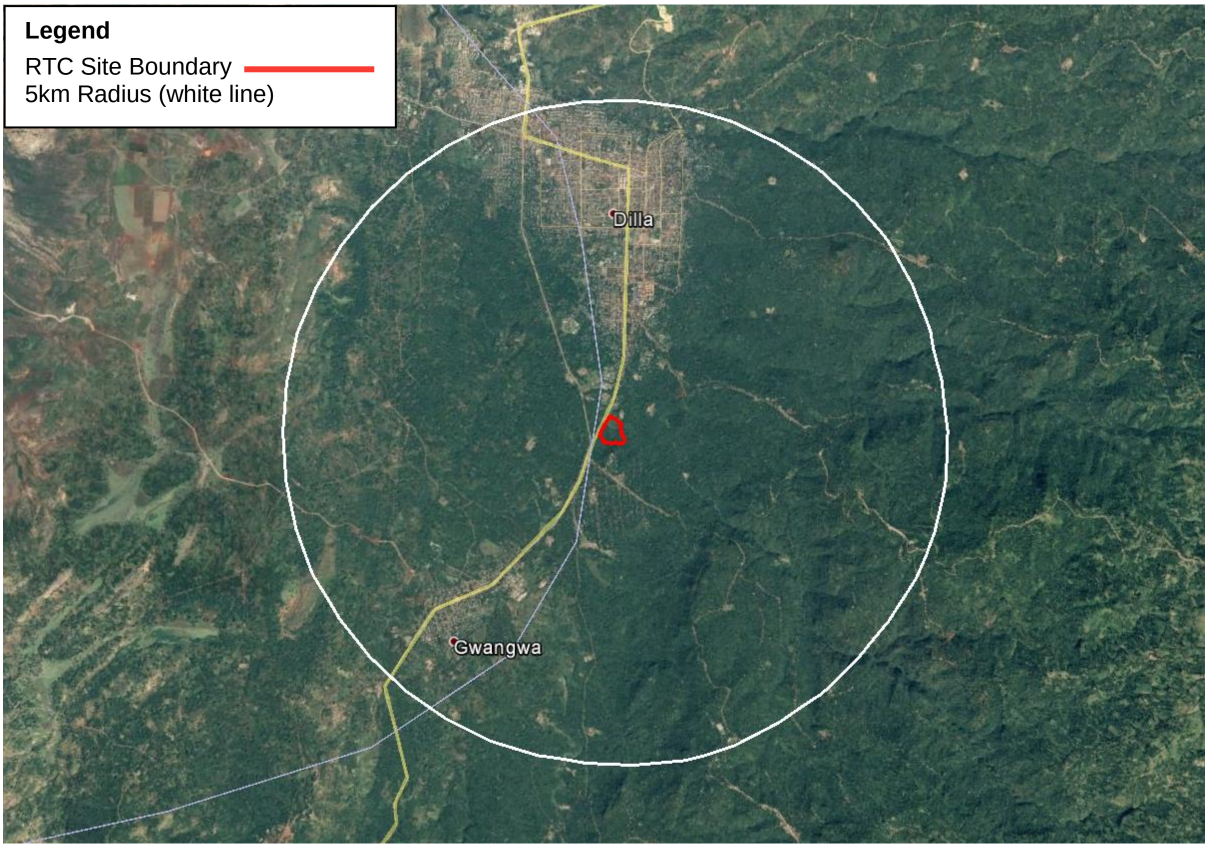

Figure 2-7: Image showing a 5km radius from the RTC site

2.2.3 DESCRIPTION

A RTC is a facility where rural communities are able to take their products (i.e. vegetables, fruits, coffee, livestock and other produce) for sale. The products are in turn forwarded in bulk to the IAIP for further processing.

The Dilla RTC site covers an extent of 9.88 ha which consists of open grassland used for grazing, low density residential properties as well as mixed agricultural land interspaced with natural vegetation.

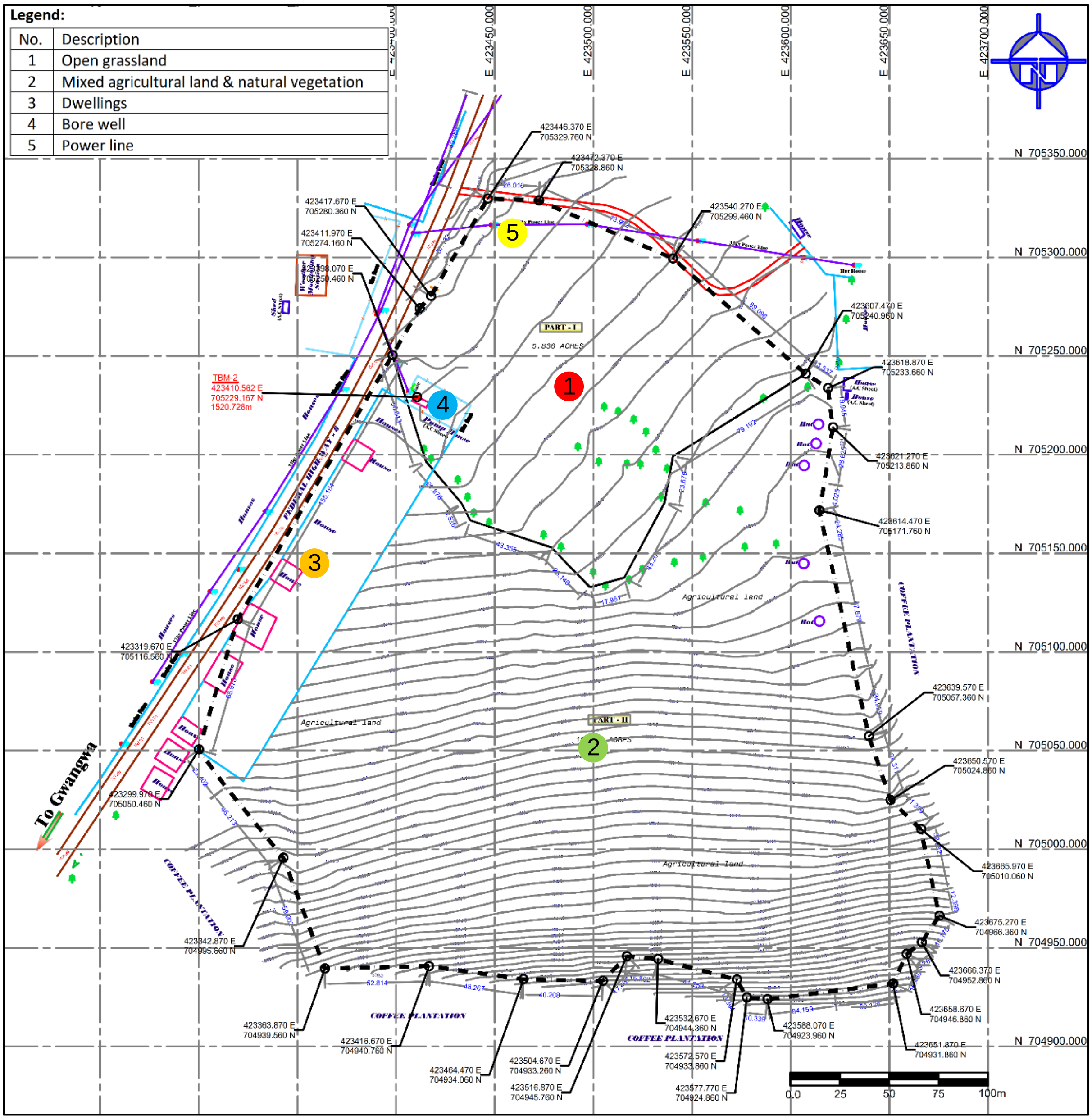

Figure 2-8: Existing features within the proposed RTC site (Source: adapted from MACE layout)

The RTC is to be focused on coffee, fruits, vegetables and cereals and livestock as well as milk, egg and honey. Furthermore the RTC contains agri-business, commercial and social infrastructure which includes processing facilities, training centres as well as health centres. The social infrastructure provides the necessary support for the occupant industries in the RTC. **Figure 2-10** provides a layout of the proposed master plan for the Dilla RTC.

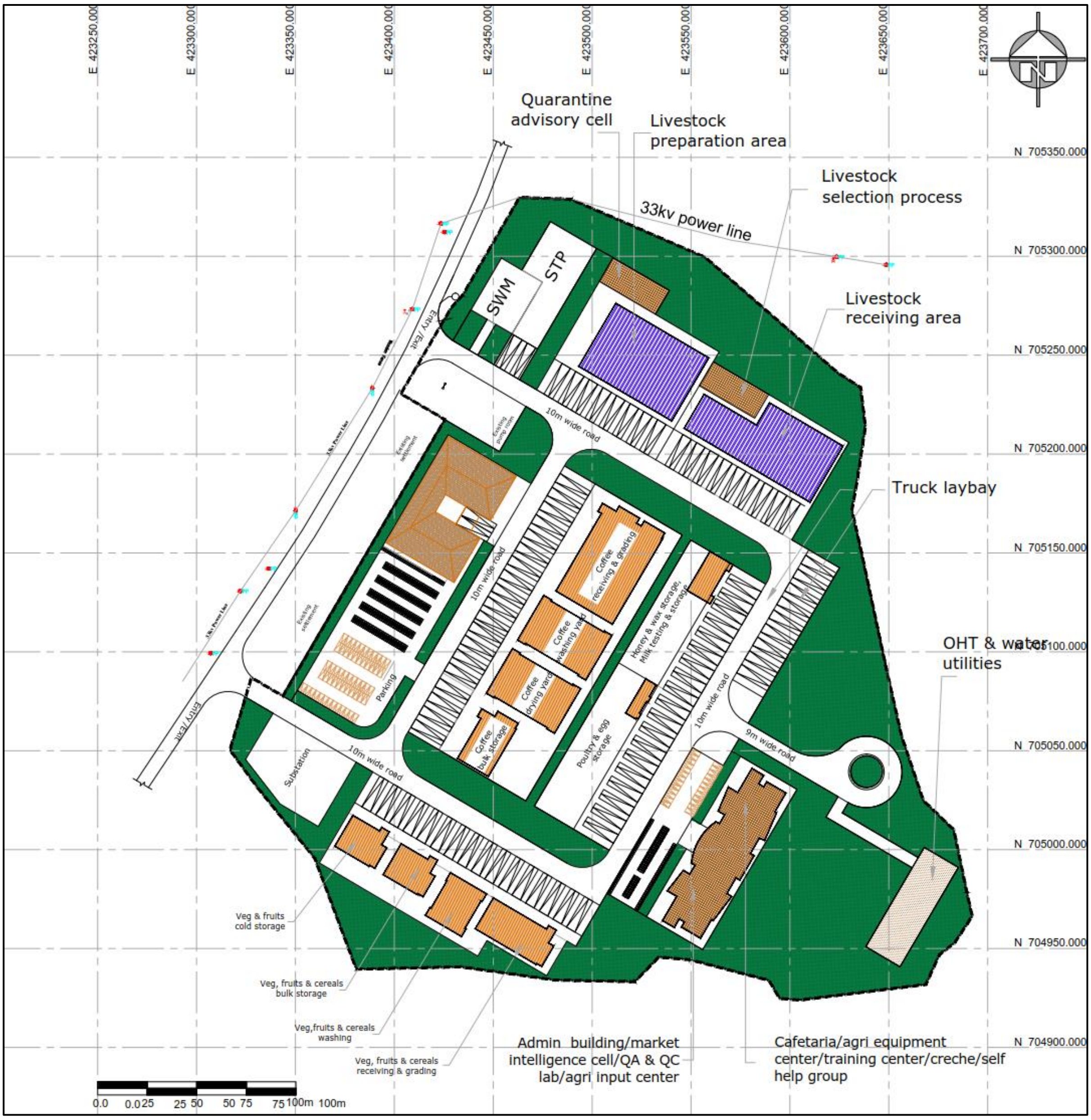

Figure 2-9: Master Plan of the Dilla RTC (Source: MACE master plan drawing)

2.2.4 PROCESS UTILITIES

WATER REQUIREMENTS

Water is supplied to the town of Dilla by the Ethiopian Water Supply and Services Enterprise (EWSSE) supply network. The total average daily water demand for the RTC is estimated to be 104 m^3/day, including potable[4] and non-potable[5] water requirements, as calculated by MACE (**Table 2-11**).

[4] Potable water is to be used for drinking and sanitary needs and washing vessels. A potable water system will be put in place that will meet regulatory requirements in terms of quality.

[5] Non-potable water considered to be used for gardening, cleaning, cooling and toilet flushing.

Table 2-11: Estimated average daily water demand for the Dilla RTC

Description	Potable (m^3/day)	Non-potable (m^3/day)	Total (m^3/day)
Total average water demand	82	22	104

To facilitate the continuous provision of water to the RTC it is proposed to construct an underground sump (UGS) with a capacity of 90 m^3 to receive and store the total daily requirement of potable water from the proposed water treatment plant. The water is to then be pumped and stored in an ELSR, with a staging height of 12 m and a storage capacity of 15 m^3.

A second UGS with a capacity of 90 m^3 is to be constructed to receive and store the total daily requirement of non-potable water from the proposed sewage treatment plant. Associated with the second UGS it is proposed that a second ELSR, also with a storage capacity of 15 m^3, is to be established for non-potable water for further distribution.

Two pump houses are to be constructed to accommodate the pumping requirements for the transfer of the potable and non-potable water.

Two potential water sources have been identified for the supply of water to the RTC, these are namely the existing bore well, of 150mm diameter to a depth of 102 m, located within the site (**Figure 2-8**) or a natural spring located approximately 3 km from the proposed site. The existing bore has however been indicated to not be in a working condition and would have to be restored to working order. The authorities are reportedly in the process of establishing infrastructure for the supply of water from the identified natural spring to the area. The establishment of such infrastructure would allow for the provision of water from the spring to the RTC site. A water treatment plant is to be established within the RTC to treat the water to meet the required water quality as per the Ethiopian drinking standard.

WASTEWATER

A STP is to be established within the RTC which will treat the operational waste water generated within the RTC to a standard that is suitable for the treated waste water to be recycled in the operational processes. Furthermore sanitary wastewater from toilets and urinals shall be collected in an underground sewer system that will be constructed as part of the processing plant's sanitary facilities. A self-contained treatment system will be put in place to treat sanitary water. Treated wastewater is to be re-used in the production process as non-potable water.

SOLID WASTE

A solid waste management area has been identified within the RTC master plan. The ESIA will provide a waste management plan for the RTC.

ELECTRICITY

The total electrical power demand for the RTC is anticipated 1.157 MVA (**Table 2-12**). It is proposed that the total power demand can be sourced from EEP via the existing 33 kV power line passing across the northern section of the site. The existing 33 kV overhead power line is to be moved to run around the site. During this process electrical infrastructure is to be connected to the proposed substation to be established on site.

Table 2-12: Estimated power demand for the RTC

Description	Quantity
Total Power Requirement	1.157 MVA

2.2.5 ANCILLARY INFRASTRUCTURE

This Section provides a brief summary of the ancillary infrastructure is proposed for the RTC.

FUEL (DIESEL/PETROL) STORAGE

The RTC includes a truck lay bay area where it is anticipated that trucks will be able to refuel.

TRANSPORT ROUTES AND ACCESS TO SITE

Entrance to the RTC is to be obtained directly off the Federal highway No. 8 via two main gates located on the western boundary of the site (**Figure 2-9**). It is noted that a new section of the federal highway has been constructed to direct traffic around the centre of Dilla. The new highway diversion is located approximately 500 m south of the RTC site (**Figure 2-10**). As such, vehicles transporting goods to or from the RTC will not have to pass through the centre of Dilla.

All internal roads will be constructed and maintained by the IPDC while the FDRE is responsible for construction and maintenance of roads outside of the RTC.

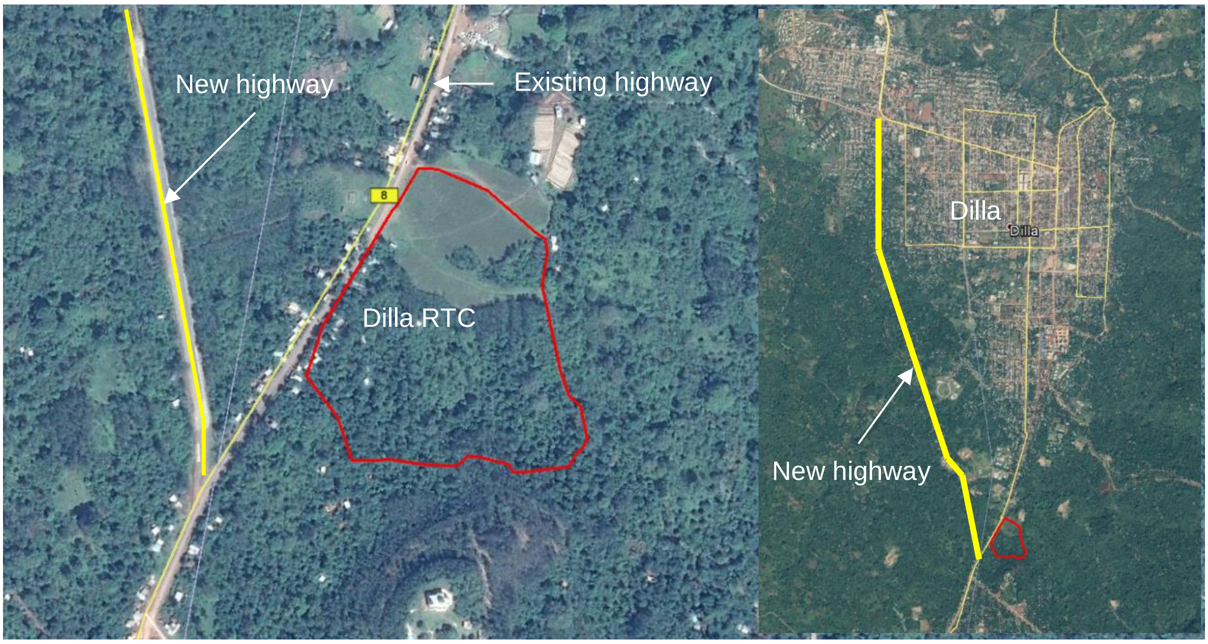

Figure 2-10: Layout indicating new section of federal highway.

ELECTRICAL OVERHEAD POWER LINES

Power is to be sourced from the rerouted overhead power line currently crossing the northern portion of the site. As per Section 2.2.4, it is reported that the EEP are to reroute the transmission line around the northern boundary of the site and provide a connection to the site for the provision of power.

COMMUNICATION FACILITIES

Communication facilities available in the town of Dilla are to be extended to the site. The installation of pipelines or infrastructure associated with the communication facilities is to be undertaken by the FDRE.

2.3 PHASES OF THE PROPOSED PROJECT

In general, development projects are undertaken in a series of set phases. Each of the phases have a different combination of activities and the commencement of each phase is dependent on the outcome and success of its predecessor. The identified Project phases are discussed below.

2.3.1 PLANNING AND DESIGN PHASE

As part of the preparation process MACE carried out the feasibility study and business plan for establishing IAIPs in Ethiopia. Following the feasibility study an engineering Scoping Study, based upon a simplified but more site-specific process, was undertaken along with the preparation of a preliminary design and associated project capital expenditure (CAPEX) and operational expenditure (OPEX) estimates corresponding to the design proposed. The engineering Scoping Study was approved by UNOPS/UNIDO resulting in the initiation of the detailed design process.

The planning and design phase of the proposed Project commenced in 2016 and will be completed once final authorisation has been issued by the relevant authorities.

2.3.2 CONSTRUCTION PHASE

Construction activities are to be undertaken in a phased manner. The construction process is to commence with the establishment of the temporary building camp for the Yirga Alem IAIP followed by construction of the boundary wall. A contractor has been appointed to undertake the construction process which includes the construction other structures such as the administration buildings, information kiosk, training centre, children facility, retail space, warehousing and production shade areas. This first phase of the construction process is anticipated to continue for a period of approximately 10 months from commencement. A total of 980 direct, and 54 indirect, employment opportunities are anticipated to be generated during this phase.

The second phase of the construction process is to include the establishment of the relevant supporting infrastructure including internal roads, electric transmission lines, poly clinic, waste water treatment plant, water supply lines, waste water disposal line, water reservoir, security cabin and street lighting. This phase of the construction process also is anticipated to continue for a period of approximately 10 months from commencement.

It is understood that the tender process for the second phase of the construction process for the IAIP is still being adjudicated as with the tenders for the RTC site.

The construction process is therefore anticipated to continue for a period of between 12-24 months from commencement, depending on the implementation of the phasing process.

2.3.3 OPERATIONAL PHASE

Once the construction phase of the Project is complete, the operational phase will commence. As mentioned earlier the Project will consist of one IAIP and one RTC, with additional RTCs to be established in surrounding areas in the future based on the success of the pilot facilities (not included in this ESIA report).

An IAIP is essentially a geographic cluster of independent firms grouped together to gain economies of scale and positive externalities by sharing infrastructure (i.e. roads, power, communication, storage, packaging, by-product utilisation, effluent treatment, logistics and transport, laboratory facilities, and the like) and taking advantage of opportunities for bulk purchasing and selling, training courses and extension services. Multiple agro-processing functions take place in an IAIP, such as final processing, storage, packaging, marketing and distribution. Support businesses and social infrastructure are also present. IAIPs include open area production zones, controlled environment growing, precision farming, knowledge hubs and research facilities, rural hubs, agri-infrastructure, collection centres, primary processing hubs, social infrastructure and agri-marketing infrastructure, among others. IAIPs are proposed to consist of state-of-the-art infrastructure including general infrastructure such as roads, power, water, communications, sewerage, sewage/effluent treatment plant, storm water systems, rain water harvesting, firefighting, etc., and specialised infrastructure such as cold storages, quarantine facilities, quality control labs, quality certification centres, raw material storage, controlled and modified atmospheric storage, central processing centres, etc.

RTCs also represent geographic clusters of infrastructure and services, though on a smaller scale than IAIPs. Farmers and farmer groups deliver their produce and receive agricultural inputs. At the

RTCs, agricultural produce is collected, sorted, stored and may undergo primary processing before onward transport to an IAIP. For most farmers, the RTCs are the main point of contact with commercial agricultural value chains. Apart from their primary functions, RTCs are also intended to offer small-scale financial services to farmers as well as basic social services. RTCs are to include warehouses, input supply, sorting, grading, extension services, pre-processing activities and microfinance commercial activities. Via the FDRE and partners the RTCs will support farmers to increase productivity to supply raw material of required quantity and quality to the industries in the IAIPs. The centres will provide information on agro-food, business development, prices, market trend and current market demand in terms of products and quality, among other services.

The operational phase involves the day-to-day management of all operations undertaken at the Yirga Alem IAIP and Dilla RTC sites and associated activities.

2.3.4 DECOMMISSIONING PHASE

The proposed IAIP and associated RTC sites are intended to be long term operational facilities (i.e. are not intended to be decommissioned in the near future). As such decommissioning requirements and activities should be considered in the planning process however detailed requirements should be addressed in the future when / if decommissioning of the facilities is required. As such decommissioning is not considered further in this report.

2.4 PROJECT STATUS

It is understood that a contractor has been appointed for phase one of the construction activities for the Yirga Alem IAIP, however that no construction activities have commenced. However, in preparation of the proposed development the following activities are being undertaken.

2.4.1 YIRGA ALEM IAIP

BOREHOLE DRILLING

Southern Water Works Construction Enetrprise has been appointed to undertake the drilling and testing of the proposed water supply boreholes for the IAIP. As per the proposal developed by MACE twelve (12) bore wells, having 300 mm diameter with a depth of 150m, were to be established to supply the anticipated required volume of water to the park based on the yield as indicated by the water authorities.

However, since MACE did not consider the '*Radius of Influence*' between the proposed boreholes, when located as per their proposal most of them spaced 100 to 150m interval with 150m depth of drilling. It was deemed necessary to amend the distances between boreholes to 500m and increase the depth of boreholes to 230m thereby doubling the discharges to 10-11 l/s and reducing the number of boreholes to six (6) only.

Drilling activities commenced in May 2017 and is anticipated to be concluded in early 2018.

COMPENSATION PROCESS

The IPDC and local authorities initiated the commencement process in 2014 with the identification of the suitable site, undertaking of the feasibility study and then identification and valuation of all affected peoples assets.

The compensation process is still underway as agreement has not yet been reached with all PAPs on the proposed compensation. A detailed description of the compensation process is provided in the Relocation Action Plan which is provided as a separate standalone document.

2.4.2 DILLA RTC

COMPENSATION PROCESS

As with the IAIP, the compensation process is still underway as agreement has not yet been reached on the proposed compensation. A detailed description of the compensation process is provided in the Relocation Action Plan which is provided as a separate standalone document

As per the legislative framework, construction activities are required to only commence following receipt of environmental certification.

3 NEED AND DESIRABILITY

The agricultural industry in Ethiopia faces the following challenges:

- Disorganized and fragmented land holdings;
- Absence of an integrated channel to link ‘farm gate to food plate’;
- Weak infrastructure, limited support services to framers;
- > 50% of Food Industries concentrated in and around Addis Ababa;
- Inability to tap the growing domestic and international markets; and
- Lack of coordination of value chain and actors.

The above challenges mean that approximately 65 million farmers are not currently linked to industry. Ethiopia has a competitive advantage in several crops such as oil seeds and cotton, and horticultural crops such as fruits and vegetables which is often lost due to poor linkages with agro-industry and limited knowledge of efficient farming practices. The fragmented nature of the agricultural sector further compounds the inefficiencies inherent in the current market.

As identified in Chapter 1, although food-processing industries are present in Ethiopia, they are currently restricted in production by the availability of raw materials. The restriction on raw material input is related mainly to access, but also due to poor quality of the produce resulting in inefficient handling chains, post-harvest losses and higher prices. Investment and development of the agro-industrial sector will improve the economy by converting the agro-export from primary, unprocessed products to processed products, which uplift economic growth in this sector and the country as a whole. The primary limitation to this proposed agro-industrial growth is the lack of adequate infrastructure. The development of agro-industries presents Ethiopia with an opportunity to accelerate economic development and achieve its industrial development goals.

In addition, Ethiopia benefits from the United States’ (US) African Growth and Opportunity Act, a law that gives many African countries duty-free export privileges to the US market. Opportunities also exist to obtain duty-free entry into the European Union (EU) countries, Canada and Japan. If addressed correctly, agro-industries can help fulfil the potential of agriculture and advance industrialisation in the country. The production of higher value products has been identified to be critical to achieving this transformation.

The IAIPs will have comparative advantages in terms of cost and efficiency allowing industries to ‘*pool resources and reduce shortages’* in the course of production. The intention is for the IAIPs to provide a ‘*one-stop-shop*’ for agricultural industries and to facilitate and boost the export earnings for Ethiopia, which is currently restricted to coffee and vegetable product exports. Investors, both local and foreign will also be attracted to incentives ranging from 70% from state banks without collateral, duty free import of machineries and spare parts, to export tax exemption. The FDRE will be seeking to attract Ethiopian diaspora business investment into the IAIPs through incentives such as offering up to 85% loans without collateral allowing the Diaspora to place only 15% of financing at risk.

The overall objectives of the IAIPs are to:

- Drive the structural transformation of the Ethiopian economy;
- Reduce rural poverty through the integration of smallholder farmers, small-scale processing enterprises and allied industries in commercial value chains; and
- Create a better environment for increased investment in agro-food and allied sectors.

The IAIPs will:

- Encourage farmers to produce more quality products through better access to market;
- Create supply-chain infrastructure;
- Increase total flows of investment in agro-industry - both in terms of skills and capital;
- Foster linkages between agriculture and agro-industry;

- Provide a close interface between research, extension mechanisms, industry and farmers in the agricultural sector;
- Increase value addition and reduce wastages, thereby increasing the income of farmers;
- Produce better quality products to increase Ethiopia's share in manufacturing value addition in the GDP;
- Create rural employment, off-farm broad based income opportunities and improve quality of life in rural areas;
- Assist small-scale agro-industrial enterprises to remain competitive in global markets; and
- Facilitate commercialisation of agriculture and increase exports of processed and value added agro-products.

The overall goal of the Government's Industrial Development Strategy (IDS) is to bring about the accelerated structural transformation of the economy through enhancing industrialization, raising the share of the industrial sector of GDP from the current 13% to 27% by 2025, and the GDP share of the manufacturing sub-sector from the current 4% to 18% by 2025.

The development of IAIPs is prioritised in Ethiopia's national development strategy and is a core component of the current Growth and Transformation Plan (GTP II, 2015-2020). This plan emphasises that economic structural transformation is central for sustainable growth and development in Ethiopia.

The proposed Project will be an important source of foreign currency inflows and taxes, as well as creating significant direct and indirect employment in the region. As a large regional project the IAIP and RTC has the potential to act as a catalyst for development of the region.

4 PROJECT ALTERNATIVES

4.1 INTRODUCTION

An ESIA process is to include an analysis of reasonable alternatives to the proposed project such as alternative sites, routes, engineering options, layouts and technologies in terms of their potential Environmental and Social impacts, the feasibility of avoiding these impacts and where this is not possible the approach to mitigating the identified impacts.

There are two types of project alternatives, these are:

- Concept Level Alternatives - which relate to site, technology and process alternatives; and
- Detailed Level Alternatives - which related to working methods and mitigation measures.

The higher level concept alternatives are addressed in this section while the detailed level alternatives are addressed through the identification and implementation of mitigation measures. The objective of the comparison of alternatives is to outline how the Project represents an optimised design that is technically and financially feasible whilst minimising overall environmental and social impacts.

4.2 CONSIDERATION OF ALTERNATIVES

Based on the project summary published by UNIDO in 2016 (UNIDO, 2016), the IAIPs were selected on the basis of six broad criteria as described below. It is noted that the issue of environment was not considered during the site selection process; this can be sited as a limitation of the feasibility and screening phases of the proposed Project.

4.2.1 AGRICULTURAL PRODUCTION POTENTIAL FOR STRATEGIC COMMODITIES

The key consideration for identifying alternatives is understanding what the primary agricultural products are in the SNNP Region, such as coffee, sesame, cereals, pulses, fruits and vegetables, livestock and honey. Once this criteria was understood, the production potential for the region was calculated to assist in developing an understanding of the land requirements for the industrial park.

4.2.2 INTER-INDUSTRY LINKAGES AND TRIGGERING EFFECT

This consideration focused on the potential linkages with existing thriving industries that could trigger further industrial development. Specifically, the existence and location of sugar plantation projects and factories, and exportable cash crop commodities were identified to help in the site selection process.

4.2.3 INFRASTRUCTURE FACILITIES

Available infrastructure is an important consideration in the location and scaling of industrial parks. Therefore the presence of power, road network, water, railways, airport terminals and telecommunication infrastructure were taken into account.

- Power – Availability of power in the growth corridors was assessed based on the presence of power stations, sub-stations and transmission lines within or near the parks.
- Road network – Road network densities for the corridors were assessed by examining national road network data from official national zonal administration boundaries.

- Water – The availability of water was analysed for both agriculture and industrial processing by considering the mean annual rainfall, availability of river systems, availability of natural and artificial reservoirs, and groundwater potential.
- Railways, dry port, airport terminals and telecommunication – Railways and dry ports were evaluated considering the current and oncoming national networks/projects.

4.2.4 MARKET POTENTIAL

A viable market for the products and services available in the park is essential for the successful establishment and the long-term commercial viability of the park. The urban sector is assumed to be the prime market for industrial agro-processed products. Thus, the urban population size of each corridor and proximity of parks to urban centres was considered.

4.2.5 ACCESS TO COMMERCIAL AND SUPPORT SERVICES

Commercial and support services such as universities, research centres, technical vocational education and training centres; farmers' cooperatives and unions; and financial institutions are very important in providing services demanded by the park. Their proximity to the parks was considered.

4.2.6 CONCENTRATION OF ENTERPRISES AND ATTRACTIVENESS FOR INVESTORS

The existence of an industrial base and facilities such as import/export logistics, housing, recreation centres, schools and other social facilities are very important for attracting investors/manpower and retaining those that may establish firms or work within the Park. The density and proximity of these facilities was taken into account.

4.3 COMPARISON OF ALTERNATIVES

4.3.1 STRATEGIC ALTERNATIVES

As part of the feasibility studies, 17 agro-industrial growth corridors (AIGC) were identified. One IAIP is planned to be developed in each of the AIGCs. Based on the results of the feasibility studies, the development of IAIPs and RTCs will take place in two phases. The first implementation phase began in February 2016 and will see a total of four pilot IAIPs and 28 RTCs developed. The selected sites are in Eastern SNNP, Central Eastern Oromia, Southwest Amhara and Western Tigray.

4.3.2 SITE ALTERNATIVES

The site selection process was undertaken by the MoI in collaboration with the local authorities and MACE. The original number and location of potential sites identified for the location of the SNNP IAIP is unknown while it has been indicated that 11 initial sites were identified for the location of RTCs. This was limited to 6 sites following the assessment. This process was undertaken at a high level and little documentation exists on the process and methods used to determine the most preferred site.

4.3.3 SITE LAYOUT ALTERNATIVES

Site layout alternatives have been considered for the Yirga Alem IAIP site. Following site selection, during the feasibility study, a site survey was undertaken to determine the sites opportunities and constraints. Based on the findings of the initial site screening assessment an initial site plan layout was prepared by MACE for the proposed Yirga Alem IAIP.

Subsequently a detailed topography survey was undertaken, which resulted in the initial site plan being revised. The site boundary was modified in certain places as well as the entry point to the proposed IAIP site.

4.3.4 SITE ACCESS ALTERNATIVES

Site access alternatives have been considered for the Yirga Alem IAIP site. Following site selection, during the feasibility study, a site survey was undertaken to determine the sites opportunities and constraints. The existing approach road was initially intended to be utilised however it was determined that the road could not be widened to accommodate the required traffic. A new alignment for an approach road was then identified (**Figure 4-1**).

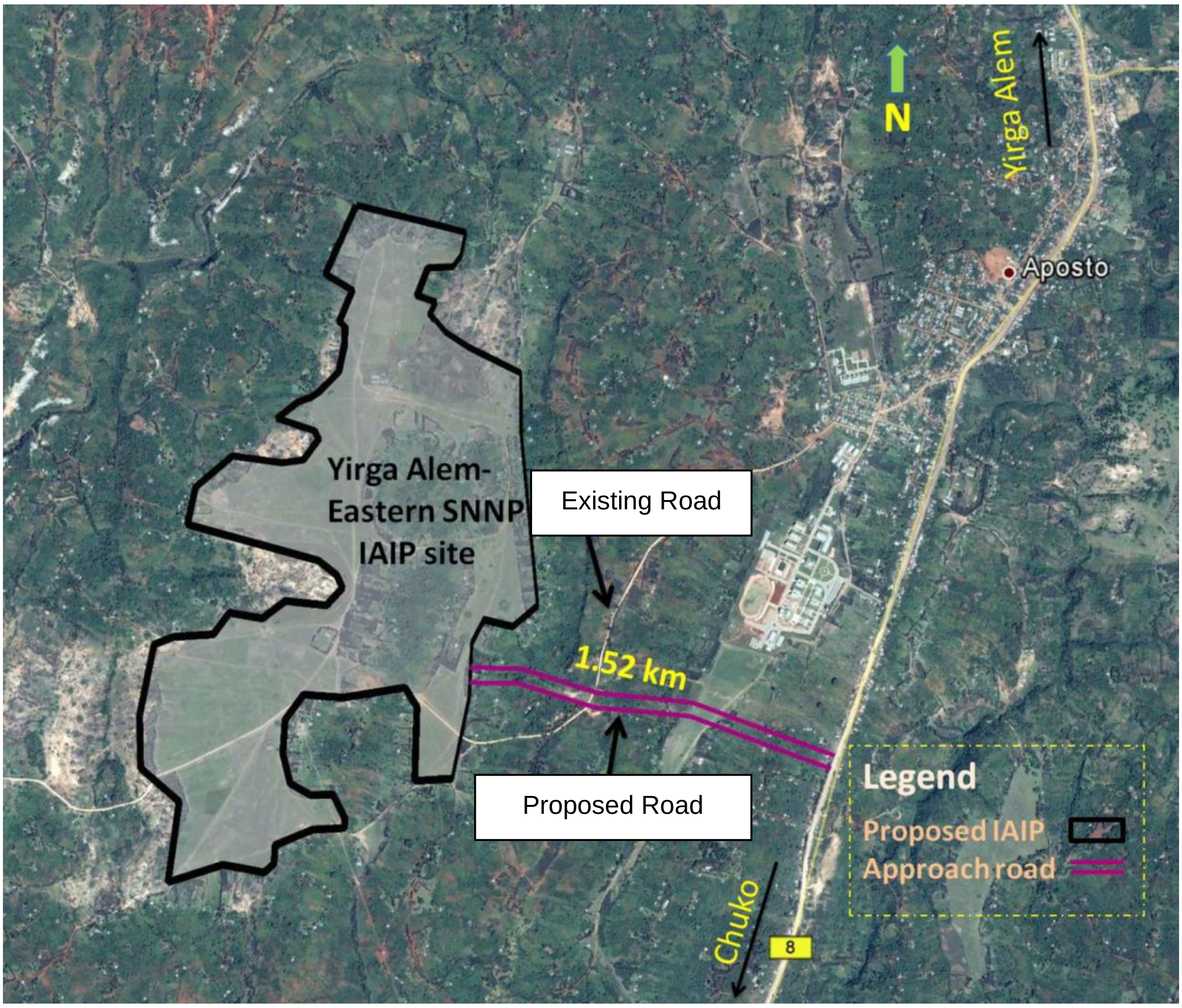

Figure 4-1: Layout showing alternative access road to the IAIP

4.3.5 TECHNOLOGY ALTERNATIVES

Various sewage treatment options were considered for the IAIP site. The sewerage treatment systems considered for selection are identified in **Table 4-1**.

Table 4-1: Sewage treatment systems considered.

No	Process	Units Required	Accessories
1	Activated sludge – extended aeration	Aeration tank and secondary clarifier	Surface aerators or membrane diffuser system for oxygen supply
2	Aerated lagoon	Earthen bund basins	Fixed or floating aerators for oxygen supply
3	Up-flow Anaerobic Sludge Blanket (UASB)	Reactor with liquid, solid and gas separation facilities	Gas collector, burner and influent distribution system
4	Trickling Filters	Circular tanks with media, under drain and secondary clarifier	Rotary distributor for influent and re-circulation pumps
5	Rotating Biological Contractors (RBC)	Trough with PVC/plastic discs, secondary clarifier	Drive mechanism for rotating the discs
6	Fluidized aerobic bio reactor	Reactor tank with poly propylene media & diffusers followed by secondary clarifier	Blowers for supply of oxygen through membrane diffusers
7	Sequencing Batch Reactor (SBR)	It uses deep RCC basins, and very efficient oxygen transfer equipment's (diffused aeration mechanism)	Diffusers, blowers and aeration grid, which provides highest aeration and oxygen transfer efficiency. Decanter assembly in Stainless steel equipped with variable frequency drive to automatically control rate of decanting based on input feed condition.
8	Membrane Bio Reactor (MBR)	Aeration tanks followed by balancing tank and membrane bio reactor	Diffusers, blowers to supply oxygen, air compressors for backwashing, chemical dosing for pre-treatment.

Factors that were considered in the selection of an appropriate treatment system included:

- Reliability;
- Vector nuisance;
- Area availability;
- Power requirement;
- Capital cost; and
- Operation and maintenance cost.

Overall the SBR system (Option 7) was identified as the preferred option as it has the lowest construction costs although the mechanical instrumentation cost is higher. In addition, the operating costs are low but this will depend on the inflow capacity of the system. The SBR system has very minimal fouling with a constant output quality. Furthermore, the system is partially automatic with low power requirements.

4.3.6 NO-GO ALTERNATIVE (I.E. THE PROJECT IS NOT ESTABLISHED)

In the event of abandonment of the Project, especially because it requires investment from international financial institutions, it could send a negative message to other international investors as

to the capacity of the FDRE to accommodate this type of industrial park project. In turn this could reduce the take up and success of other mega projects being planned / implemented in Ethiopia.

Without the SNNP IAIP and RTC project, economic development of the SNNP Region will be compromised in the short term. The Ethiopian Agricultural sector's potential to support the next generation will remain constrained as a result of restrictions in available land and limited diversity of income sources. The lack of industrialisation of the agricultural sector will limit the revenue base which would leave the GDP of the country still heavily dependent on the agricultural sector.

Finally, without the Project, there would be no additional impacts, either positive or negative, on the physical, biological and social environments, although existing pressures on resources and infrastructure will continue, in some cases leading to the deterioration of the quality of life for future generations. Since the ESIA demonstrates that the overall balance of impacts is positive, primarily as a result of the employment opportunities for the current and future generations and the anticipated contribution these projects will make to the Ethiopian GDP. Therefore the abandonment of the Project would deprive the country and local communities of these benefits. Job creation expected during the construction and operational phases, as well as the positive outfalls on the health and education sectors would also not materialise.

5 LEGAL FRAMEWORK

This Chapter provides a high-level overview of the institutional and legislative framework for the ESIA associated with the proposed Project.

5.1 INSTITUTIONAL FRAMEWORK

As per Chapter 2 the proposed IAIP site is located in the Eastern SNNP Region with the IAIP located in the Sidama zone and the RTC located in the Gedeo zone.

The current system of government in Ethiopia is organised into a federal structure, comprised of the federal government, nine regional states and two city administrations. EIA administration in Ethiopia is shared between the federal government and regional states. The Environmental Protection Organs Establishment Proclamation (295/2002) established the institutions responsible for the enforcement and regulation of EIAs; these include the Federal Ministry of Environment, Forestry and Climate Change (MEFCC,) Regional Environmental Agencies and the Sector Environmental Units. In addition the delegated sector Ministries which, through Federal MEFCC delegation, have been assigned the dual role of ensuring timely and effective enforcement for preparation of sector specific EIAs authorised/licensed at Federal level as well as of reviewing EIA reports.

FEDERAL MINISTRY OF ENVIRONMENT, FORESTRY AND CLIMATE CHANGE (MEFCC)

The MEFCC is the lead agency responsible for formulating policies, strategies, laws and standards to ensure social and economic development activities sustainably enhance human welfare and safety of the environment (Article 6, Proclamation 295/2002). The enforcement and administration of EIAs is one of the key responsibilities entrusted to the MEFCC. In this respect, the MEFCC is responsible for establishing and updating the system for undertaking EIAs in public and private sector projects. The MEFCC is responsible for developing directives that identify categories of projects likely to generate adverse impacts and require a full EIA, and for issuing guidelines that direct preparation and evaluation of EIA reports (Proclamation 299/2002, Articles 5 and 8). As per proclamation 916/2015, the MEFCC have bestowed among others with the following powers and duties:

- Coordinate activities to ensure that the environmental objectives provided under the Constitution and the basic principles set out in the Environmental Policy of the Country are realised;
- Establish a system for evaluating and decision making, in accordance with the Environmental Impact Assessment Proclamation, the impacts of implementation of investment programs and projects on environment prior to approvals of their implementation by the concerned sectoral licensing organ or the concerned regional organ;
- Coordinate actions on soliciting the resources required for building a climate resilient green economy in all sectors and at all Regional levels; as well as provide capacity building support and advisory services;
- Establish an environmental information system that promotes efficiency in environmental data collection, management and use;
- Enforcing and ensuring compliance to the EIA proclamation which currently is being implemented through delegated authority provided to sector ministries;
- Reviewing EIAs and monitoring the implementation of EIA recommendations which is also in part being implemented through delegated authority provided to sector ministries;
- Regulating environmental compliance and developing legal instruments that ensure the protection of the environment;
- Ensuring that environmental concerns are mainstreamed into sector activities; and
- Coordinating, advising, assessing, monitoring and reporting on environment-related aspects and activities.

In addition, the Federal MEFCC is responsible for evaluating EIA reports of projects that need to be licensed and executed by the federal government and projects that are likely to generate inter-regional impacts. The Federal MEFCC is also responsible for monitoring and auditing the

implementation and performance of such projects. The Federal MEFCC holds primary responsibility for providing technical support on environmental protection and management to regional states and sector institutions

REGIONAL ENVIRONMENT, FOREST AND CLIMATE CHANGE BODIES

Proclamation 295/2002 requires regional states to establish or designate their own regional environmental agencies. The regional environmental agencies are responsible for coordination, formulation, implementation, review and revision of regional conservation strategies as well as environmental monitoring, protection and regulation (Article 15).

Relating to EIA specifically, Proclamation 299/2002 gives regional environmental agencies the responsibility to evaluate EIA reports of projects that are licensed, executed or supervised by regional states. Regional environmental agencies are also responsible for monitoring, auditing and regulating implementation of such projects.

SECTOR ENVIRONMENT UNITS:

The other environmental organs stipulated in the Environmental Protection Organs Establishment Proclamation (295/2002) are 'Sector Environmental Units' which have been established in some of the line Ministries. These Sector Environment Units have the responsibility of coordinating and implementing activities in line with environmental protection laws and requirements (Article 14, Proclamation 295/2002). To this end, Sector Environmental Units play an important role in ensuring that EIA is carried out on projects initiated by their respective sector institution.

DELEGATED AUTHORITY:

The MEFCC has delegated authority to sector institutions to ensure implementation of EIAs in their sector and to undertake EIA reviews. For instance, the Federal Ministry of Industry, Agriculture, Mining as well as Water, Energy and Irrigation are responsible for ensuring that an EIA is undertaken on their sectoral projects and to review an EIA.

5.2 POLICY AND LEGAL FRAMEWORK IN ETHIOPIA

The following policies and legal frameworks are identified to be relevant to the proposed Project and associated ESIA.

- Constitution of the Federal Democratic Republic of Ethiopia (1995), specifically Articles 43, 44 and 92 as well as Article 40.
- Environmental Policy of Ethiopia (1997).
- Environmental Impact Assessment Proclamation (299/2002), which makes EIAs a mandatory requirement for the implementation of major development projects, programs and plans in Ethiopia.
- Ethiopian Water Sector Policy (2001), whereby the Ministry of Water, Irrigation and Electricity will need to be consulted with regards to what water permitting/licensing requirements will be necessary for the successful implementation of the proposed Project.
- Water Resources Management Proclamation (197/2000). For the protection of water resources (both surface- and groundwater) of Ethiopia.
- Water Resources Management Regulation (115/2005), which provides detailed provisions for the effective implementation of its parent legislation, the Water Resources Management Proclamation.
- Water Resources Utilisation Proclamation (92/1994), regulating the use of water resources, by requiring a government permit in respect of most water uses.
- River Basin Councils and Authorities Proclamation (534/2007), for the promotion and monitoring of integrated water resources management for Ethiopia's river basins.

- Environmental Pollution Control Proclamation (300/2002), which restricts release of gaseous, liquid or solid wastes to the environment exceeding the environmental standards and advocates a “polluter pays” policy.
- Prevention of Industrial Pollution Council of Ministers Regulation (159/2008), which is directed to detail the implementation of pollution control proclamation with focus on industry.
- Solid Waste Management Proclamation 513/2007, which aims to promote community participation to prevent adverse impacts and enhance benefits resulting from solid waste management.
- Policy for Rural Development (2003), given the dominance of agriculture in the Ethiopian economy, the rural development effort is presently associated with agricultural development. In order to facilitate agricultural development, there is a need to undertake rural infrastructure and social development programmes.
- Labour Proclamation (377/2003) as amended, requiring that the employer takes the necessary measures to adequately safeguard the health and safety of their workers.
- Public Health Proclamation (200/2000), which disallows the discharge of untreated effluent waste generated from septic tanks, seepage pits and industries into water resource. It also prohibits the disposal of solid or liquid wastes or any other waste in a manner which contaminates the biophysical, physical or social environments.
- The Federal Democratic Republic of Ethiopia Rural Land Administration and Land Use Proclamation (456/2005), which applies to all rural land in Ethiopia. The proclamation aims to conserve and develop natural resources through the development of and implementation of sustainable land use planning.
- Payment of Compensation for Property Situated on Landholding Expropriated for Public Purposes Regulation (135/2007), which provides a formal approach for the payment of compensation and to assist livelihood restoration for displaced persons.
- Accession to African Human and People’s Rights Charter Proclamation (114/1998), formalising the Ethiopian Governments support for regional and international efforts to achieve normative standards for basic human rights.
- Convention for the Safeguarding of the Intangible Cultural Heritage Ratification Proclamation (484/2006), which formalises the adoption of the Convention for the Safeguarding of the Intangible Cultural Heritage in Ethiopia at the General Conference of the United Nations Educational, Scientific and Cultural Organisation in Paris on 17 October 2003. The Ethiopian Government ratified the said Convention on 24 January 2006.

5.3 SPECIFIC LEGAL FRAMEWORK FOR INDUSTRIAL PARKS IN ETHIOPIA

The legal instruments identified below have been specifically developed for the purposes of providing National controls and regulations to all industrial parks developed in Ethiopia. The IAIP developments will therefore be governed by this legal framework.

5.3.1 INDUSTRIAL PARK PROCLAMATION NO. 886/2015.

The Industrial Park Proclamation No. 886/2015 defines an industrial park as being an area with a distinct boundary designated by the appropriate organ to develop comprehensive, integrated, multiple or selected functions of industries, based on a planned fulfilment of infrastructure and various services such as road, electric power and water. These parks are intended to be a ‘one stop shop’. The proclamation then identifies the key role players as the ‘Industrial Park Developer’, ‘Industrial Park Operator’ and the ‘Industrial Park Enterprise’. Before any of these entities can commence with any construction or operation of a business or enterprise within the park they will require an ‘Investment Permit’ issued by the commissioner. This permit will allow the Industrial Park Developer, Operator or Enterprise to carry out industrial park development related activities.

In terms of Article 6(4) of the proclamation the Industrial Park Developer is required to adhere to the performance requirements for the phased development of the industrial park as well as any financial obligations and time schedules for financial and debt financing, specified in the permit. The Developer will also be required to comply with other obligations specified in the Proclamation, the Regulation (see below), environmental protection legislation and other applicable laws. The Industrial Park Operator is obliged to meet the permit terms. Article 8(6) states that the Industrial Park Operator is also obligated to comply with social and environmental as well as any other obligations as provided for in this Proclamation, the Regulation, applicable laws and its permit or agreement.

Article 10(4) obligates the Industrial Park Enterprise to comply with this Proclamation and the Regulation in general and the environmental, social and employer obligations in particular contained therein and in other applicable laws. Article 28(1) states that the Labour Proclamation No 377/2003 (as amended) shall be applicable in any industrial park.

Article 24(2) requires the MEFCC to establish offices within the industrial parks for the application, supervision, protection and enforcement of environmental norms and standards, safeguards, management and mitigation plans within the industrial parks.

Article 28(5) requires the Ministry of Industry to facilitate technology transfer and skills development in general and domestic manufacturing sector capacity building in particular mainly through clustering and other best practice approaches.

This Proclamation does provide an avenue for enforcement of compliance with the contents of the Proclamation in that Article 30(a) allows for the issuance of a reprimand, suspension and revocation of the permit.

5.3.2 INDUSTRIAL PARKS COUNCIL OF MINISTERS REGULATIONS NO. 417/2017.

The Industrial Parks Council of Ministers Regulation provides more detailed requirements in relation to Industrial Parks. Article 5(5) states that 25% of the land set aside for the industrial park may not be developed. All land to be used for the purposes of factories, buildings, facilities for common use, infrastructure, residence and related buildings within the industrial parks area shall neither be less than 50% nor exceed 75% of the land under possession. Article 5(8) requires that an ESIA be undertaken and the necessary certificate received from the competent authority. Article 9(2) states that an environmental impact assessment report is required before an investment permit can be issued.

The Regulation also places controls over construction activities by requiring in Article 11(7) for the Commission to oversee and ensure construction of an enterprise confirms with the relevant laws.

Article 18(1) requires the Ministry of Industry and other relevant organs to make sure that industrial parks recruit workers, foster skills development and transfer, and transfer and upgrading of technology; they shall also ensure supply and render support in regard to the realisation of these. Article 18(2) requires that the Ministry of Industry shall design training programs that enable transfer of skills and knowledge to Ethiopian workers.

5.4 NATIONAL STRATEGIES AND PLANS

The following national strategies and plans have been identified to be relevant to the proposed Project and associated ESIA.

- Conservation Strategy of Ethiopia;
- Ethiopia’s Climate-Resilient Green Economy Strategy
- National Growth and Transformation Plan II; and
- Ethiopian Agro-Industry Sector Strategy.

5.5 NATIONAL STANDARDS, DIRECTIVES AND GUIDELINES

The following national standards, directives and guidelines have been identified to be relevant to the proposed Project and associated ESIA.

- Environmental Standards for Industrial Pollution Control in Ethiopia - These standards present pollution limits for emissions to (i) atmosphere, (ii) water resources and (iii) noise emissions.
- EIA Directive No. 1/ 2008, A Directive to Determine Projects Subject to Environmental Impact Assessment - The directive lists the various activities that require the undertaking of an EIA prior to the commencement of that specific activity. This includes the construction of tanneries, abattoirs, industrial waste disposal facilities and industrial zones.
- Draft Guideline for Environmental Management Plan for the Identified Sectorial Developments in the Ethiopian Sustainable Development & Poverty Reduction Programme (ESDPRP), May 2004 - The guideline outlines the necessary measures for the preparation of an EMP for proposed developments in Ethiopia and the institutional arrangements for implementation of EMPs.
- EIA Guideline, July 2000, - This guideline provides a background to environmental impact assessments and environmental management in Ethiopia.
- The Federal Environmental Protection Authority, Environmental Assessment Reporting Guide, 2004, Addis Ababa - The guideline provides a standardised reporting framework for environmental assessments. It is however the responsibility of proponents and associated assessors to ensure that sufficient information is included in environmental assessments and that this information is forwarded onto all concerned and interested environmental agencies for review and consideration.

5.6 REGIONAL PLANS

Regional plans are to be reviewed and taken into consideration when developing mitigation / management measures during the ESIA process. Regional plans should align with national development plans to ensure project sustainability.

5.7 INTERNATIONAL CONVENTIONS, PROTOCOLS AND AGREEMENTS

Ethiopia is signatory to a number of international conventions and agreements, and in certain cases these have influenced the development of policies, guidelines and regulations. The ESIA will need to consider these conventions and agreements and ensure compliance during the planning, construction and operation phases of the proposed Project.

The following international conventions and protocols, to which Ethiopia is a signatory, are to be considered:

- International Labour Organisation (ILO) Forced Labour Convention, 1930 (No. 29);
- ILO Freedom of Association and Protection of the Right to Organise Convention, 1948 (No. 87);
- ILO Right to Organise and Collective Bargaining Convention, 1949 (No. 98);
- ILO Equal Remuneration Convention, 1951 (No. 100);
- ILO Abolition of Forced Labour Convention, 1957 (No. 105);
- ILO Discrimination (Employment and Occupation) Convention, 1958 (No. 111);
- ILO Minimum Age Convention, 1973 (No. 138);
- ILO Worst Forms of Child Labour Convention, 1999 (No. 182);
- ILO Right of Association (Agriculture) Convention, 1921 (No. 11);

- ILO Tripartite Consultation (International Labour Standards) Convention, 1976 (No. 144);
- The United Nations Convention on the Rights of the Child, 1990;
- The Stockholm Convention on Persistent Organic Pollutants;
- Convention on Biological Diversity;
- The United Nations Framework Convention on Climate Change, 1992;
- The United Nations Convention to Combat Desertification in those Countries Experiencing Serious Drought and/or Desertification, Particularly in Africa;
- The United Nations Convention for the Safeguarding of the Intangible Cultural Heritage;
- The United Nations Convention on the Protection and Promotion of the Diversity of Cultural Expressions;
- The United Nations Convention Concerning the Protection of World Cultural and National Heritage;
- The Vienna Convention for the Protection of the Ozone Layer;
- Montreal Protocol on Substances that Deplete the Ozone Layer;
- The Rotterdam Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade;
- Libreville Declaration on Health and Environment in Africa;
- The United Nations Convention on International Trade in Endangered Species (CITES) of Wild Fauna and Flora, 1973; and
- The United Nations Convention on Biological Diversity (Rio Convention), 1992.

5.8 INTERNATIONAL GUIDELINES AND STANDARDS

5.8.1 OVERVIEW

Environmental and social impacts as well as sustainability are key principles for many international financing organisations. Various guidelines and standards exist, each varying in the areas of focus and level of detail required, with regards to environmental and social requirements for proposed projects. These include the AfDB Integrated Safeguards System, World Bank Group (WBG) Operational Policies and Environmental, Health and Safety (EHS) Guidelines as well as the International Finance Corporation (IFC) Performance Standards.

Each of these above guidelines and standards cover essentially the same scope (environmental, labour, social, health and safety, supply chain etc.) The AfDB has their own integrated safeguards system based on the IFC standards, but exclude the extensive and detailed guidance notes for their standards. This typically provides more flexibility (and less stringency) in application of their standards.

In broad terms, all multilateral development banks include key common features in their safeguards in that they all require an environmental and social assessment, they all address the issue of involuntary resettlement, pollution prevention, biodiversity, indigenous peoples, and cultural heritage. There is some variation in relation to the level of inclusion by some banks of important social issues such as community impacts and labour conditions and environment flows.

The World Bank and IFC requirements are broadly identical. The primary differentiation is that the World Bank applies to projects where funding is going to government-affiliated projects/lenders (including parastatals), whereas IFC applies to funding going to pure private sector borrowers. The Ethiopian Government in collaboration with UNIDO have elected to apply the AfDB Integrated Safeguards System as the regulatory framework for the ESIA to follow.

The following sections identify the relevant AfDB Integrated Safeguards System which is applied to projects to promote growth that is socially inclusive and environmentally sustainable. The purpose of

the safeguards is to avoid adverse impacts of projects on the environment and affected people while maximising potential development benefits. Where avoidance is not possible mitigation and compensation should be implemented to manage the environmental and social risks.

5.8.2 AFRICAN DEVELOPMENT BANK INTEGRATED SAFEGUARD SYSTEM

The AfDB adopted the Integrated Safeguard System (ISS) as a tool for identifying risks, reducing development costs and improving project sustainability. The ISS promotes best practices in these areas but also encourages greater transparency and accountability and protects the most vulnerable communities. The AfDB encourages member countries to observe international human rights norms, standards, and best practices on the basis of their commitments made under the International Human Rights Covenants and the African Charter of Human and Peoples' Rights.

The AfDB ISS builds on the two previous safeguard policies, Involuntary Resettlement (2003) and Environment (2004), and on three cross-cutting policies and strategies: Gender (2001), the Climate Risk Management and Adaptation Strategy (2009) and the Civil Society Engagement Framework (2012). The bank has now adopted five Operating Safeguards (OSs) to achieve the goals and the optimal functioning of the Integrated Safeguards System (ISS). These OSs are:

- **Operational Safeguard 1**: Environmental and Social Assessment: this is an overarching safeguard of determining a projects environmental and social category and the resulting environmental and social assessment requirements.
- **Operational Safeguard 2:** Involuntary resettlement land acquisition, population displacement and compensation: this consolidates policy commitments and requirements contained in the Bank's policy on involuntary resettlement, and incorporates a number of refinements designed to improve the operational effectiveness of those requirements.
- **Operational Safeguard 3:** Biodiversity and ecosystem services: this seeks to conserve biological diversity and promote the sustainable use of natural resources with a focus on integrated water resources management in operational requirements.
- **Operational Safeguard 4:** Pollution prevention and control, hazardous materials and resource efficiency: this covers the range of key impacts of pollution, waste, and hazardous materials for which there are agreed international conventions, as well as comprehensive industry-specific and regional standards, including greenhouse gas accounting. The Bank's new screening tool for climate change risk helps in screening and categorising a project in terms of its vulnerability to the risks of climate change.
- **Operational Safeguard 5:** Labour conditions, health and safety: this relates to workers conditions, rights and protection from abuse or exploitation.

The AfDB requires that an assessment be conducted according to the principles of proportionality and adaptive management. Therefore the level of assessment and management required should be proportionate to the level of risk that the project poses. This is determined through the project categorisation and scoping phase. Project categorisation follows the principle of using the appropriate type and level of environmental and social assessment for the type of operation. A Category 1 project is likely to cause significant environmental and social impacts and therefore must subject to a full ESIA process, whereas a Category 2 project is likely to cause less adverse environmental and social impacts and a simplified ESIA is applicable.

The AfDB therefore categorises projects based on the anticipated significance of environmental and social impacts. One defining factor revolves around the level of resettlement a project is anticipated to result in. Where a project will involve 200 or more persons or the project is likely to have an adverse effect on vulnerable groups then the project will require a Full Resettlement Action Plan and is deemed a Category 1 Project. Where a project will displace fewer than 200 people and where land acquisition and potential displacement and disruption of livelihoods are less significant, then the project is deemed to be a Category 2 Project.

Based on the census data collected by the IPDC, the proposed SNNP Project (including the IAIP and RTC facilities) will result in 229 PAPs being affected by a combination of economic and physical displacement, 176 PAPs being economically displaced, 18 PAPs being physically displaced, and 44 PAPs being affected where their familial graves will need to be moved, resulting in a **total 467 PAPs**.

Therefore the SNNP Project (Yirga Alem IAIP and Dilla RTC) is considered a **Category 1 Project** and is subject to a full ESIA assessment process.

The AfDB standards do not provide detailed guidelines on methodological requirements in some specialist areas and therefore in such cases the South African standards have been applied as these are more aligned with the IFC standards and are therefore considered to suitably meet international good practice.

6 THE ESIA PROCESS

The Environmental and Social Impact Assessments (ESIAs) and Resettlement Action Plans (RAPs) will be undertaken to African Development Bank (AfDB) requirements. AfDB requires that the level of assessment undertaken should be proportionate to the level of risk that the project poses. The AfDB therefore categorises projects based on the anticipated significance of environmental and social impacts. The defining factor revolves around the level of resettlement a project is anticipated to result in. Where a project will involve 200 or more persons or the project is likely to have an adverse effect on vulnerable groups then the project will require a full RAP and is deemed a Category 1 Project. Where a project will displace fewer than 200 people and where land acquisition and potential displacement and disruption of livelihoods are less significant, then the project is deemed to be a Category 2 project.

The SNNP IAIP and RTC site is considered a **Category 1** project based on the number of people affected by the Project. A Category 1 project must have a full ESIA process undertaken. The key steps to an AfDB ESIA are presented below.

6.1 SCOPING PHASE

The purpose of the scoping phase is to detail the key sensitivities and activities that have the potential to contribute to, or cause, potentially significant impacts to environmental and socio-economic receptors and resources and to evaluate siting, layout and technology alternatives for the proposed project.

The key objectives of scoping are to:

- Identify and detail the potentially most significant impacts;
- Obtain stakeholder views through consultation; and
- Develop the Terms of Reference (ToR) for the ESIA through consultation so as to ensure that the process and output are focused on the key issues.

6.1.1 STAKEHOLDER ENGAGEMENT

The key principle of consultation is to ensure that the views of stakeholders are taken into account and reported throughout the ESIA process. The objective is to ensure the assessment is robust, transparent and has considered the full range of issues or perceptions, and to an appropriate level of detail.

Stakeholders include those individuals, groups or organisations who themselves could be directly affected by the proposed Project (Project affected people) and those individuals or organisations who, although not directly affected by the proposed Project, represent those affected or have a regulatory duty, an interest, influence or secondary involvement in the proposed Project (secondary stakeholders).

Stakeholder engagement commenced with the IPDC having undertaken discussions with Project Affected People (PAPs) and compiling a survey of all affected households, including individuals, details of dwellings and extent of property / farmland associated with each household to inform the relocation and compensation process.

During the site investigation stage, stakeholder engagement meetings were undertaken by the consultant to provide detailed information about the Project to the community as well as to obtain feedback from the local community in terms of the Project. The findings from the stakeholder engagement process undertaken to date are presented in Chapter 7 and reflected in the minutes of the stakeholders and community consultation meetings (attached in **Appendix B**).

Stakeholder engagement is to continue throughout the ESIA process ensuring that legislative requirements and Project standards are met, that stakeholder concerns are addressed in the assessment and that sources of existing information and expertise are identified.

6.1.2 BASELINE DATA COLLECTION

One of the main objectives of the Scoping stage of the ESIA process is to collect suitable data on the physical, biophysical and social environment, so as to understand what receptors and resources have the potential to be significantly affected by the proposed Project. The data will also describe the baseline conditions of the environment that will be used during the impact assessment phase for both social and environmental impacts.

Site investigations were undertaken by the ESIA team from 16 – 25 August 2017, from 31 August to 7 September 2017, from 21 – 24 September 2017, from 11 - 14 October 2017 and from 21 – 23 October 2017. The findings of the site investigations, and description of the baseline environment of the sites, are presented in Chapter 8 of the Report.

6.1.3 INTERACTION WITH DESIGN AND DECISION-MAKING

Interaction between the ESIA team and the design and decision-making process is one of the key areas in which an ESIA can influence how a project develops. It includes involvement in defining the Project and identifying those activities with the potential to cause environmental and socio-economic impacts (e.g. site clearing, noise, traffic, relocation, local employment).

Project planning, decision-making and refinement of the Project description are to continue throughout the assessment process as a result of the development of the proposed Project and in response to the identified impacts. This process has the potential to alter the site layout, processes or technology identified to prevent or, where prevention is not possible, mitigate identified impacts.

6.1.4 SCOPING REPORT

The steps detailed above are captured within a Scoping Report (dated November 2017). The Scoping Report included the terms of reference for the ESIA based on the baseline environment and the potential impacts identified. The Scoping Report provided recommendations in terms of the scope of the ESIA and the methods to be used to determine the significance of potential impacts. The Scoping Report was submitted to the MEFCC for approval on 2 December 2017.

The MEFCC issued comments on the Scoping Report on 21 December 2017. A formal response to the comments was issued by the ESIA Team on 26 December 2017, addressing the comments raised by the MEFCC.

6.2 IMPACTS ASSESSMENT PHASE

6.2.1 IMPACT DESCRIPTION AND DEFINITION

IMPACT DEFINITION

Environmental impacts from planned and non-planned activities during all phases of the Project are assessed on the basis of detailed knowledge and industry experience of these activities. For the purpose of this ESIA an environmental or socio-economic impact is defined as:

"*Any change to the environment, whether adverse or beneficial, wholly or partially resulting from an organisation's activities or services*." (ISO 14001)

Prediction of impacts is an objective exercise to determine what is likely to happen to the environment as a consequence of the Project and its associated activities. From the potentially significant interactions identified in scoping, the impacts to the various resources/receptors are elaborated and evaluated. The diverse range of potential impacts considered in the impact assessment process typically results in a wide range of prediction methods being used, including quantitative and semi

quantitative techniques, for example noise impacts on sensitive surrounding community receptors, and qualitative techniques for assessing certain socio-economic impacts on communities.

DESCRIPTION OF IMPACTS

Environmental impacts arise as a result of Project activities either interacting with environmental or social receptors directly, or causing changes to the existing environment such that an indirect effect occurs.

Environmental and social impacts from a planned event are those resulting from the routine and intended construction or operations/activities associated with the IAIP and RTC facilities (e.g. regular truck movements to and from the facilities transferring produce to market). Environmental and social impacts from unplanned events occur as a result of incidents or 'upset conditions'. Typical examples of impacts occurring from unplanned events include (but are not limited to) spills, leaks, odours and fires.

The impacts identified for the proposed Project are described in Chapter 9 of this report.

NATURE OF IMPACT

The nature of an impact is defined as the type of change from baseline conditions. The nature of an impact is described as being either **positive (+ve)** or **negative (-ve)**.

TYPE OF IMPACT

Impact type indicates the relationship of the impact to the Project activity in terms of cause and effect, as either:

- **Direct impact** resulting from the direct interaction between a project activity and the receiving environment; or
- **Indirect impact** which include secondary or induced impacts caused by a change in the Project environment (e.g. employment opportunities created by the supply chain requirements);or
- **Cumulative impact**; where a Project impact acts together with other impacts (including those from concurrent or planned future third party activities) to affect the same resources and/or receptors as the Project.

SCALE OF IMPACT

Impact extent relates to the geographic reach of the impact and is described as:

- **Local impact** would affect local resources or receptors and would be restricted to a single community (i.e. impacts in the footprint of Project activities and the immediate adjacent area);
- **Regional impact** would affect regional resources or receptors and would be experienced at a regional scale;
- **Trans-boundary impact** would be those that are experienced in one country as a result of activities in another.

DURATION OF IMPACT

Impact duration refers to the time period over which a resource or receptor will be affected, and includes:

- **Temporary impacts** would be of a very short duration, are reversible and intermittent or occasional in nature. The resource or receptor would return to the previous state when the effect ceases or after a short period of recovery;
- **Short-term impacts** would last for a short duration (2 to 5 years) and are usually limited to the construction period. The impact would cease when the effect ceases following a short period of recovery;
- **Medium-term impacts** would last for over five years but less than fifteen years (5 to 15 years). The impact would cease following rehabilitation and a period of recovery;

- **Long-term impacts** would continue for an extended period of time (e.g. beyond 15 years), or cause a more permanent change in the affected receptor or resource that endures substantially beyond the Project lifetime.

PROBABILITY

The *probability* of an event occurring and creating an impact on a given receptor is designated using a qualitative scale from 1 to 4, the higher values being more probable that an impact will occur, see **Table 6-1** below.

Table 6-1: Probability rating of impact

Rating Scale	Description
1	**Unlikely** - very improbable, never heard of in the industry, or an event with a short duration (probably will not happen).
2	**Low probability** - incident has occurred in the industry and so therefore could occur, or an event lasting up to a day (some possibility, but low likelihood).
3	**Medium Probability** - incident has (or is) expected to occur during the project or is very likely to, or an event which may occur up to 1 month (distinct possibility).
4	**High probability** - incident is expected to happen frequently a year or is almost certain to happen, or an event which is expected to occur multiple times (most likely).

SEVERITY

The severity of an impact, on a given receptor is designated using a rating scale from 1 to 4 and defined in **Table 6-2** (Environmental Severity) and **Table 6-3** (Socio-economic Severity) below, the high values denoting a more severe impact.

Table 6-2: Definitions of Severity used in the ESIA for Environmental Receptors

Category	Environmental Receptors – Physical And Biological	
	Negative	**Positive**
4 - High	Major, long term national, international or transboundary effects. Deterioration/improvements of the existing habitat or ecosystem baseline conditions is significant. Rehabilitation is required or the baseline will not recover. Results in changes / reduction in the abundance and biodiversity of populations which may or may not recover. Such impacts are a major non-compliance with national and international regulatory standards and may result in immediate intervention by governmental bodies and stakeholders.	Baseline will be significantly improved by the project. Results in changes / increase in the abundance and biodiversity of populations. Exceed national and international regulatory standards in protection and creation of natural habitats.
3 - Medium	Moderate, medium term deterioration / impact on the ecosystem on a local / national level, leading to observable and measurable changes.	Moderate, medium term rehabilitation of ecosystems or national significance, leading to observable and measurable changes.

Category	Environmental Receptors – Physical And Biological	
	Moderate deterioration / improvements and changes / reduction in the abundance and biodiversity of the area with moderate recovery periods to baseline conditions. Non-conformance with national and international regulatory standards which may result in the intervention by governmental bodies and stakeholders.	Moderate deterioration/improvements and changes / increase in the abundance and biodiversity of the area with moderate recovery periods to baseline conditions. Conformance with national and international regulatory standards.
2 - Low	An effect will be experienced but they will be minor, short term and local, leading to observable and measurable changes recoverable within short durations. Potential non-conformance with regulatory standards. Unlikely to result in concerns being raised by governmental bodies or stakeholders. Minor deterioration of ambient environmental conditions and recovery requires little or no intervention.	An effect will be experienced but they will be minor, short term and local, leading to observable and measurable changes recoverable within short durations. Partial conformance with regulatory standards. Meets governmental and stakeholder requirements. Minor improvements to ambient environmental conditions.
1 - Very Low	Deemed 'imperceptible' or indistinguishable from natural background conditions.	Deemed 'imperceptible' or indistinguishable from natural background conditions.

Table 6-3: Definitions of Severity used in the ESIA for Socio-Economic Receptors

Category	Socio Economic Receptors	
	Negative	**Positive**
4 - High	Highly significant, loss or major damage with medium to long term effect on cultural and/or natural resources of national and regional importance which are essential for communities' livelihood. Highly significant negative impacts on the national and international community (regional, i.e. neighbouring countries). Those affected will be able to adapt to changes with some difficulty/ease, and will only be able to maintain pre-impact livelihoods with a degree of support. Immediate intervention by governmental bodies requiring rapid implementation of response measures. National and International media and community concerns and ongoing long term complaints.	Retention of all cultural and heritage resources of value on site. Highly significant positive impacts on the national and international community (regional, i.e. neighbouring countries). Those affected will be able to adapt to changes with some difficulty/ease, and will only be able to maintain pre-impact livelihoods with a degree of support. Project meeting and exceeding Government policies and plans. National and International media and community support.
3 - Medium	Moderate damage to archaeological, cultural or key natural resources of local or national importance.	Retention of cultural heritage resources (of value) where possible and

Category	Socio Economic Receptors	
	Moderate negative impacts on the regional or national population. Vulnerable groups significantly affected. Changes affecting livelihoods, amenity values, convenience and quality of life of study population. National and potentially international media and community concerns and ongoing long term complaints.	appropriate recording of resources that cannot be retained. Moderate positive impacts on the regional or national population. Vulnerable groups significantly affected. Changes affecting livelihoods, amenity values, convenience and quality of life of study population; National media and community support.
2 - Low	An effect will be experienced but they will be Minor, short term effects recoverable within short durations. Unlikely to result in concerns being raised by governmental bodies or stakeholders. Measurable negative impacts that are intermittent or effect a small minority of the local population and / or vulnerable groups. May result in concerns from local communities.	An effect will be experienced but they will be Minor, short term effects of short durations. Meets governmental and stakeholder requirements. Measurable positive impacts that are intermittent or effect a small minority of the local population and / or vulnerable groups.
1 - Very Low	Deemed 'imperceptible' or indistinguishable from natural background conditions. No public interest.	Deemed 'imperceptible' or indistinguishable to current social norms and variations. No public interest.

EVALUATION OF SIGNIFICANCE OF IMPACT

Based on the above methodology, the impacts resulting from the project are classified within this ESIA as either positive or negative with a specific severity rating.

All environmental and social impacts have been identified based on the information summarised in this ESIA and their significance is assessed and classified by combining the probability and severity scores as shown in **Table 6-4**, which relates to negative impacts, or **Table 6-5** which relates to positive impacts below.

In assessing whether an impact is significant, reference has been made, where appropriate, to criteria on which the evaluation is based. These may include legislative requirements, policy guidance or accepted practice and past experience.

Table 6-4: Significance Matrix Negative Impacts

Significance			Probability Rating			
			Very low	Low	Medium	High
			1	2	3	4
Severity Rating	Very low	1	**Negligible**	**Minor**	**Minor**	**Minor**
	Low	2	**Minor**	**Minor**	**Moderate**	**Moderate**
	Medium	3	**Minor**	**Moderate**	**Moderate**	**Major**
	High	4	**Minor**	**Moderate**	**Major**	**Major**

Table 6-5: Significance Matrix Positive Impacts

Significance			Probability Rating			
			Very low	Low	Medium	High
			1	2	3	4
Severity Rating	Very low	1	**Negligible**	**Minor**	**Minor**	**Minor**
	Low	2	**Minor**	**Minor**	**Moderate**	**Moderate**
	Medium	3	**Minor**	**Moderate**	**Moderate**	**Major**
	High	4	**Minor**	**Moderate**	**Major**	**Major**

CATEGORIES OF IMPACT SIGNIFICANCE

The different significance categories reflected by the colour scheme used in the above matrix and within this ESIA reflect the following:

- **Negligible** - no additional action is required and the impact is already reduced to as low as reasonably practicable (ALARP);
- **Minor** - where the level of risk is broadly acceptable and generic control measures are already assumed in a design process but, where appropriate, require continuous improvement.
- **Moderate** - where the level of risk is tolerable but control measures are required to reduce the risk as far as is practicable (i.e. tolerable if as low as reasonably practicable (ALARP)).
- **Major** - changes to the project are required which requires a re-assessment of applicable mitigation and / or reconsideration of alternatives and options by the project design team.

6.2.2 CUMULATIVE IMPACTS / EFFECTS

Cumulative impacts and effects are those that arise as a result of an impact and effect from the Project interacting with those from another activity to create an additional impact and effect. These are termed cumulative impacts and effects. The ESIA considers the cumulative effects that could arise from a combination of IAIP and RTC project effects with those of other existing or planned developments in the surrounding area (refer to Chapter 10).

Typical examples arise from impacts of nearby pre-existing or proposed new developments on local communities who may also be exposed to further impacts from the proposed Project. In addition, the cumulative impact assessment include other developments which might take place as a consequence of the project, e.g. to provide access, power or water supplies, sewage treatment or waste disposal, or to house or provide jobs for people attracted to the area by the project.

6.2.3 DEALING WITH UNCERTAINTY

Even with a final design and an unchanging environment, impacts are difficult to predict with certainty, but in projects such as the proposed Project where the design process is currently in progress, uncertainty stemming from on-going development of the Project design is inevitable. Additional uncertainty may stem from issues such as variability in the natural environment between seasons and from one year to another. Where such uncertainties are material to the ESIA findings, they are clearly stated and conservatively approached (‘the precautionary approach’) in order to identify the broadest range of likely residual impacts and necessary mitigation measures.

6.2.4 MANAGEMENT SYSTEMS INTEGRATION

Stakeholders and external decision-makers for the proposed Project will rely on the findings of the ESIA (e.g. as regards significance of residual impacts) in coming to their ultimate views. As an ESIA is

based on predictions made in advance of an activity taking place, it effectively makes assumptions that the project will implement certain controls and mitigation measures. If the controls do not happen, then the ESIA is undermined as a tool for stakeholders and external decision-makers. It is important, therefore, that these 'assumptions' (i.e. the mitigation measures), are commitments that will be implemented through the environmental and social management plan (ESMP) and associated management and monitoring plans that have and will be developed together with the proponent as part of the ESIA.

Once potential impacts have been identified and mitigation measures developed and described in the ESIA, their integration within the proposed Project is required in order to ensure their future implementation. In order for this to be successful, management plans including the responsibility, timing and reporting requirements associated with each measure, or set of measures, are compiled and form part of the authorisation.

Refer to the Chapter 11 for the ESMP for the proposed Project.

7 STAKEHOLDER ENGAGEMENT

This Chapter presents a summary of the general stakeholder engagement activities undertaken as part of the ESIA process.

7.1 APPROACH TO STAKEHOLDER ENGAGEMENT

Stakeholder engagement for the ESIA has been undertaken using a staged approach in line with the various phases of the ESIA process. The engagement process generally involved the following five key phases.

7.1.1 INITIAL ENGAGEMENT AND RELOCATION PROCESS ENGAGEMENT

The Ethiopian Constitution makes reference to the right of the public and communities to full consultation and participation as well as to the expression of their views in the planning and implementation of projects that would affect them. The Ethiopian EIA Guidance also identifies that all interested and affected parties have the opportunity to participate meaningfully in the ESIA processes.

Initial engagement with PAPs was undertaken by the IPDC with the introduction of the project and initial survey of the households. This process was undertaken during September 2014, whereby the IPDC identified likely PAPs, farms and communal facilities to be affected. From October to December 2014 the feasibility study was undertaken, following which community meetings were held at both sites to present the findings and obtain feedback. In March 2015 broader community and stakeholder meetings were held at both sites. Following this, the regional administration conducted consecutive community meetings before and after making the required value assessments regarding likely PAPs and assets to be affected. These meetings were held in Yirga Alem and Dilla towns. The meetings were facilitated by the task force/ Committee organised from the Zonal Administration. The purpose of the post valuation meetings were to present the proposal of the task force about the compensation and resettlement valuations and obtain feedback from the PAPs.

Specific meeting dates and content of meetings held are presented in **Table 7-1** below

Table 7-1: Record of initial engagement and relocation process engagement carried out by the local authorities for the SNNP Yirga Alem Site

Date of Meeting	Site	Content	Attendees
Dec. 28, 2014	Yirga Alem, IAIP	Briefing about the project's benefit, nature, size required resources including land and related development activities. Obtaining feedback and opinions of the local community. General principles and approach about compensation and resettlement issues.	PAPs and community representatives (more than 300)
Jan. 1, 2015	Dilla, RTC	Briefing about the project's benefit, nature, size required resources including land and related development activities. Obtaining feedback and opinions. General principles and approach about compensation and resettlement issues.	More than 40 PAPs

Date of Meeting	Site	Content	Attendees
March 24, 2015	Yirga Alem, IAIP	Presentation and validation of the feasibility study	PAPs and community representatives (more than 500)
March 24, 2015	Dilla, RTC	Presentation and validation of the feasibility study	PAPs and community representatives (more than 50)
Aug. 22, 2016	Yirga Alem, IAIP	Valuation procedures, disciplines, principles, methods, etc.	PAPs
Aug. 23, 2016	Dilla, RTC	Valuation procedures, disciplines, principles, methods, etc.	PAPs
Sept. 23, 2017	Yirga Alem, IAIP	Presenting proposal of the task force about the compensation and resettlement and obtain feedback of PAPs	PAPs and local community / more than 600 persons
Sept. 29, 2017	Yirga Alem, IAIP	Second meeting presenting amended proposal of the task force about the compensation and resettlement and obtain feedback of PAPs	PAPs and local community / more than 600 persons
Oct. 3, 2017	Yirga Alem, IAIP	Third meeting presenting amended proposal of the task force about the compensation and resettlement and obtain feedback of PAPs	PAPs and local community / more than 600 persons

Key items raised during the engagements include:

- As long as PAPs and the local inhabitants are treated properly that community would be happy with the project (sustained livelihood restoration, job priority, better income, etc.);
- Method of compensation, in cash or in-kind was not clear to all participants;
- When the project will be started - clarifications were requested;
- The need to ensure access to the local health centre;
- Query regarding the youth group who do not have their own land, but used to cultivate on their family's farm;
- How to address issues related to the church that found in the proposed area?
- The need to avoid bad experiences related with compensation due to projects' PAPs;
- The need to start the project as soon as possible;
- Doubt about realisation of the project as per the presented / promised strategy, doubts if any benefit will go to the people, concerns about timely project accomplishment, satisfactory compensation and livelihood restoration, etc.
- RTC site has no sensitive public facilities like on the IAIP site;
- Participants want the concerned government authority to **pay compensation in cash and not in kind** as they are doubtful about getting substitute land of good quality and in favourable location and in a timely manner because population density of the area is very high and land is scarce.

These meetings focused on sourcing information on primary agricultural products for the area and the product value as well as compensation calculations and the valuing of assets. More detail on the resettlement has been provided within the RAP which is a separate standalone document.

7.1.2 STAKEHOLDER IDENTIFICATION AND ANALYSIS

Stakeholder identification and analysis is an essential component of effective and meaningful stakeholder engagement activities. A comprehensive stakeholder engagement plan has been developed identifying who the key stakeholders are and how they should be engaged. The Stakeholder Engagement Plan (SEP) is provided in **Appendix B1**.

The objective of the analysis was to provide a general overview of all stakeholders and their stake in the project. Specifically, the stakeholder analysis sought to:

- Identify institutions, groups, and individuals likely to impact or be impacted by the proposed project;
- Categorise identified stakeholders in relation to their operation scope and mandate; and
- Assess the identified stakeholder's interests, significant and influence in relation to the proposed project.

Key stakeholders groups are listed, but not limited to, those listed below:

- Project Affected Peoples;
- Compensation task force;
- Regional Bureau of Trade and Industry;
- Sidama Zone Administration;
- Gedio Zone Administration;
- Dale Woreda Administration;
- Zuria Woreda Administration;
- Local administrative units;
- Agriculture Development & Natural resource Management (Regional, Zonal and District offices);
- Construction and Housing (Zonal and District Office);
- Trade and Industry (Regional, Zonal and District Office).

7.1.3 MODE OF INFORMATION DISSEMINATION

Stakeholders were engaged and identified through:

- One-on-one consultations with key stakeholder representatives;
- Focus group workshops;
- Community public meetings; and
- Distribution of project background information document (copy is included within **Appendix B2**).

Table 7-2 provides a stakeholder engagement plan matrix outlining key stakeholders, their importance and roles within the Project.

Table 7-2: Stakeholder Engagement Plan Matrix

Stakeholder	Impact *How much does the project impact them? (Low, Medium, High)*	Influence *How much influence do they have over the project? (Low, Medium, High)*	What is important to the stakeholder?	How could the stakeholder contribute to the project?	How could the stakeholder block the project?	Strategy for engaging the stakeholder
Ministry of Industry	*High*	*High*	*Successful development and implementation of the IAIP and RTC projects*	*As project proponent and owner, it has all the leverage towards Successful development and implementation of the IAIP and RTC projects*	*As project proponent and owner, it has all the leverage towards Successful development and implementation of the IAIP and RTC projects*	*Continued reporting and consultation on preparation and implementation issues of the ESIA and RAP*
Ministry of Environment, Forest and Climate Change (MEFCC)	*Low*	*High*	*Implementation of the IAIP and RTC development projects in environmentally and socially sustainable way.*	*The MEFCC will review the ESIA and RAP reports and will supervise the implementation of the ESMP.*	*As regulatory body it has all the mandate to correct unsustainable environmental and social practices of the projects*	*Continued reporting and consultation on preparation and implementation issues of the ESIA and RAP*
SNNP National Regional State IPDC	*High*	*High*	*Job creation, Agriculture Value chain enhancement, improved standard of living of farmers*	*Facilitate the smooth progress of the development project by allocating budget for resettlers, and relevant offices*	*As the ultimate benefactor and proponent of the project, it will work towards the successful completion of the project.*	*Continued reporting and consultation on implementation issues of the ESIA and RAP*
SNNP Regional Environment Forest, Wildlife Protection and	*Low*	*High*	*Implementation of the IAIP and RTC development projects in*	*The EFWPDA is the regional regulatory body responsible to ensure*	*As regulatory body it has the entire mandate to correct unsustainable*	*Continued reporting and consultation on implementation*

Stakeholder	Impact *How much does the project impact them? (Low, Medium, High)*	Influence *How much influence do they have over the project? (Low, Medium, High)*	What is important to the stakeholder?	How could the stakeholder contribute to the project?	How could the stakeholder block the project?	Strategy for engaging the stakeholder
Development Authority			*environmentally and socially sustainable way.*	*environmental compliance of the development projects during construction and operation.*	*environmental and social practices of the projects.*	*issues of the ESIA and RAP*
Yirga Alem Town Administration	*Medium*	*Medium*	*Resettlement of Households and compensation to clear site for construction*	*Responsible for spearheading the resettlement and compensation process*	*Handing over the site for IAIP is already done but successful resettlement process including livelihood restoration will have an impact on the project.*	*Invite to all stakeholder engagement activities as part of the ESIA*
Project Affected Farmers and Residents	*High*	*Medium*	*Provision of adequate compensation, support for smooth resettlement and livelihood restoration.*	*The project affected farmers and residents will promptly evacuate from project site upon compensation and resettlement support.*	*Project affected farmers and residents can remain on project site.*	*Active and continuous consultation and engagement with the PAPs till the resettlement and livelihood restoration is complete.*
Community Representatives, including elderly, women, youth and PAPs	*Medium*	*Medium*	*Delivering positive impacts of the project such as job creation, enhanced commercial and*	*The community representatives can create a bridge of communication with the community to*	*Negative attitude of the community in the project area can hamper the construction and*	*Active and continuous engagement with community representatives*

Stakeholder	Impact *How much does the project impact them? (Low, Medium, High)*	Influence *How much influence do they have over the project? (Low, Medium, High)*	What is important to the stakeholder?	How could the stakeholder contribute to the project?	How could the stakeholder block the project?	Strategy for engaging the stakeholder
			economic activities, community health and wellbeing during operation and infrastructure development in the town and the neighbourhood such as roads, electricity, etc.	*positively contribute towards the project*	*operation of the development project*	*during all stages of the development project.*

7.1.4 SCOPING ENGAGEMENT AND BASELINE DATA GATHERING

Engagement during the Scoping phase was undertaken by the ESIA team with an initial introductory meeting with representatives of the local community held on 16 August 2017 at the Yirga Alem IAIP site and 17 August 2017 at the Dilla RTC site.

These meetings were followed with stakeholder and community meetings held within the period from 1 - 6 September 2017.

The objective of the engagements were to:

- Formally notify stakeholders of the proposed Project and the ESIA process;
- Formally initiate the engagement process and introduce the engagement team;
- Table and elicit comment from the affected parties; and
- Provide stakeholders with an opportunity to ask questions and give input on the proposed Project.

Relevant engagement materials were generated by the ESIA consultants to support the engagement activities. The content thereof was written in a non-technical / accessible language in English and Amharic. The material included information on the following:

- A background and description of the proposed Project;
- The environment in which the proposed Project is to be developed;
- Information on the client;
- Information on the ESIA process and timelines;
- Typical impacts associated with similar Projects; and
- Information on the ESIA consultants and their independence.

Due to the potential for high instances of illiteracy amongst potentially impacted groups in the proposed Project area, community meetings were held to be able to present the information and obtain feedback verbally as well as in writing. Engagement during the Scoping phase has involved consultation with stakeholders at the federal, regional, and local levels.

Additionally this phase included gathering of primary data for the socio-economic baseline. It is noted that the collection of this information involved one on one engagement with stakeholders. This provided stakeholders additional opportunities to provide feedback and ask questions regarding the proposed Project. It is understood that initial baseline data gathering was also previously undertaken by MACE as well as the IPDC prior to commencement of the ESIA process.

Stakeholder engagement included key government stakeholders at the Town, Woreda and Kebele level, as well as community based organisations and local community members.

Table 7-3 and **Table 7-4** provide a summary of consultation meetings held in the Yirga Alem and Dilla areas.

Table 7-3: Summary of stakeholder consultation undertaken at Yirga Alem IAIP site

Meeting	Date	Consultation with	Participants
1	September 3, 2017	PAPs and surrounding community	Project Affected Persons and local community members representatives
2	September 4, 2017	Education Office	Mr. Bereket Befekadu (Office Head)
3	September 4, 2017	Environmental Protection and Forest Development Office	Mr. Amdualem Taddele (Office Head)
4	September 4, 2017	Yirga Alem Town Administration	Mr. Sermiso Samual (Mayor of Yirga Alem Town)
5	September 4, 2017	Urban Agriculture Office	Mr. Kebebew Dekamo (Office Head)

Meeting	Date	Consultation with	Participants
6	September 5, 2017	Trade and Industry Office	Mr. Selemon Sintayehu (Office Head)
7	September 5, 2017	Yirga Alem Health Centre	Mr. Minas Arega (Office Head)

Table 7-4: Summary of stakeholder consultation undertaken at Dilla RTC site

Meeting	Date	Consultation with	Participants
1	September 1, 2017	PAPs and surrounding community	Project Affected Persons and local community members representatives
2	September 1, 2017	Dilla Woreda Zuria Education Office	Mr. Elias Bedaso (Office Head) Mr. Petros Worku (Deputy Office Head) Mr. Tamerat Worku
3	September 1, 2017	Dilla Woreda Administration Office	Mr. Shibru Miju (Office representative)
4	September 1, 2017	Dilla Zuria Health Office	Mr. Andualem Mamo
5	September 2, 2017	Dilla Environmental Protection Office	Mr. Mesfin Dori (Office Head)
6	September 2, 2017	Farming and Natural Resources Development Office	Mr. Abiyot Hordofa (Office Head)
7	September 2, 2017	Industry Office Representative	Mr. Temesgen Kebede

The community meeting consultees identified the following important issues:

- Issue on the estimate of compensation and assets valuation.
- Compensation rates on perennial crops need to be agreed on before compensation amounts are paid to the affected farmers.
- The need to provide training on how to use the compensation money of the affected groups.
- Farmers receiving compensation for their affected crops require training on micro-finance and money management.
- Issue on how to safely dispose waste that will be generated from the sites.
- Issue on how to upgrade skills of work force.
- Major health problems of the area and what need to be done in the future.
- Issue of long period (approximately 2 years) since initial communication regarding the project and latest comprehensive communication.
- Issue of provision of benefits to local communities, especially women and children.
- Issue on job creation to the youth.

Minutes of the meetings and supporting photographs are provided within **Appendix B3**.

7.1.5 ESIA DISCLOSURE ENGAGEMENT

In November 2017 the Impact Assessment process had been completed and the engagement team returned to site to gather stakeholder comment and feedback on the ESIA. This engagement was targeted at allowing local stakeholders an insight into the predicted impacts and mitigation and to contribute their local knowledge to the assessment and mitigation process. This process afforded stakeholders the opportunity to confirm that their needs, fears and aspirations have been recorded and where possible appropriately considered in the specialist investigations and Project design **Table 7-5** provides a summary of ESIA consultation meetings held in the Yirga Alem and Dilla areas. Minutes of the meetings and supporting photographs are provided within **Appendix B4**.

Table 7-5 : Summary of ESIA Phase consultation meetings held within the Project area.

Meeting	Date	Venue	Stakeholders
1	19 November 2017	Dilla	More than 20 participants representing different sections of the community including elderly, women, youth and PAPs
2	19 November 2017	Yirga Alem	More than 30 participants representing different sections of the community including elderly, women, youth and PAPs

The community meetings consultees identified the following important issues:

- The community members and the stakeholders emphasized their full support for this project realization. They all said, we they are eagerly waiting for it and want to stand with them to support it.
- The compensation for land and assets has not yet been paid and the reason for the delay has not been clearly provided.
- The estimated value of their property is too small.
- Not ploughed the land for the last two years (i.e. after it was demarcated for the development).
- Lack of respect with which they have been treated. For example, the officials held the meeting to present the estimated property values at the Yirga Alem Police College. This was considered as an intimidation mechanism by the local community.
- Issue of having to open joint bank accounts with wives, taking as insult as the community indicated that they do not suspect each other in their culture. What is a husband's property is also deemed to belong to the wife.
- Priority in obtaining job opportunities at the park have been promised, however the construction company that won the bid to build the boundary wall has brought employees from outside of the area to work.
- Specific detail of what crops the IAIP / RTC will require is unclear, if this is known the locals can prepare.

Responses to these issues include:

- A separate RAP process is being undertaken in which the compensation process and proposed valuation will be reviewed against the requirements of the national legal requirements as well as against the AfDB requirements. Where shortfall are identified these will be indicated and additional compensation is to be paid (should it be required).
- A management plan is being compiled as part of the ESIA process which identifies requirements that the IPDC have to abide by. This includes that priority for jobs are to be provided to the PAPs and local communities, especially women and youth.

It is important to note that complaints will and must be solved properly and in time through consultation among the stakeholders and the IPDC in order to ensure the success of the project. In general, the meetings were very lively and participants acknowledged their satisfaction by getting the opportunity to air their views in the consultation meeting and urged that solutions be put forward in the

ESIA study for the issues they raised. Finally they endorsed the project and asked for its rapid implementation.

7.2 PROJECT STAKEHOLDERS

For the purposes of this process, a stakeholder is defined as any individual or group which is potentially affected by the proposed Project or who has an interest in the proposed Project and its potential impacts. A diverse range of stakeholders have been identified that could be involved in the stakeholder engagement process. Furthermore, different issues are likely to concern different stakeholders.

Project stakeholders identified to date are identified in the Stakeholder Engagement Plan included in **Appendix B1** and in the stakeholder minutes provided in **Appendix B3 and B4**.

7.3 FEEDBACK MECHANISM

Each round of engagement undertaken has provided stakeholders with an opportunity to provide input and feedback on the proposed Project. However, it remains important to offer opportunities to people to both provide feedback and receive response at other times in-between formal rounds of engagement.

A feedback mechanism is therefore in place during the Scoping and ESIA process to ensure that potential concerns raised by stakeholders during engagement are acknowledged and addressed in a timely, structured and culturally appropriate manner.

8 THE RECEIVING ENVIRONMENT

8.1 INTRODUCTION

It is important to gain an understanding of the physical attributes of the Project area and its surroundings, as it will provide for a better understanding of the receiving environment in which the Project is being considered.

The description of the baseline environment is essential in that it represents the conditions of the environment before the construction of the proposed Project. The description of the baseline environment therefore provides a description of the current, or status quo, environment against which environmental impacts of the proposed Project can be assessed and future changes monitored.

The information presented in this Chapter has been collected from desktop studies and supplemented with site visits to the Project area. It must be noted that very little secondary data is available for the SNNP Region as a whole, and in many instances, data is currently wholly unavailable. As such, the objective of primary data collection served to minimise these significant data gaps. The methodologies used to aid data collection are discussed in the respective sections below.

The following characteristics of the receiving environment for the Yirga Alem IAIP site and the Dilla RTC site are described.

Table 8-1: Characteristics of the receiving environment for Project area considered.

Receiving Environment	Characteristics
Physical	• Climate; • Topography and Geomorphology; • Geology; • Soils; • Surface Water (Hydrology); • Groundwater (Hydrogeology); • Wetlands; • Air Quality; • Noise; • Waste Management; • Transport / Access; • Visual.
Biological	• Biodiversity
Socio-Economic	• Demographics; • Ethnicity, religion and languages; • Social Infrastructure and services; • Economy and livelihood activities; • Cultural heritage.

8.2 CLIMATE

Climate in the region generally ranges from semi-arid in the rift floor to humid in the mountains of the escarpment. In the highlands and escarpment bounding the rift floor average precipitation exceeds 1200 mm/year, whilst at the lowest altitude in the rift floor precipitation is often below 800 mm/year. Precipitation is characterised by a bimodal pattern with maximum peaks during April and May (“small

rainy" season) and during September and October in the "main rainy" season. Like in most parts of Ethiopia, the diurnal variation of air temperature in the basin is more visible than its seasonal variation.

8.2.1 TEMPERATURE

Meteorological data for 20 years (1981-2010), was collected from Yirga Alem Station which is the nearest station to the project site. Based on the data collected the mean monthly temperatures were calculated and are presented in **Table 8-2** below. The mean monthly temperature lies in the range 15-20°C for most of the year, occasionally rising over 20°C in the months of April and May.

Table 8-2: Mean monthly temperature (°C) for the period 1981 – 2010 (Yirga Alem Station)

Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Yirga Alem	19.4	19.7	20.5	19.8	19.3	18.8	18.2	18.3	18.4	18.7	18.8	19.0

Meteorological data for 23 years (1988-2010), was collected from the Dilla Meteorological Station, which is the nearest station to the project site. Based on the summarised data the maximum and minimum temperatures registered are 39.6°C and 3.2°C respectively, the mean monthly temperatures are presented in **Table 8-3** below. The annual mean average temperature is 20.4°C. It is noted that the daily variation in temperature in the area is more pronounced than the annual variation.

Table 8-3: Mean monthly temperature (°C) for the period 1988 – 2010 (Dilla Station)

Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Yirga Alem	20.1	20.9	21.6	21.4	20.5	20.1	19.8	20.1	20.0	20.1	19.9	19.7

8.2.2 PRECIPITATION

The Yirga Alem rainfall station was chosen to represent the SNNP IAIP site due to the proximity. Based on the twenty years (1981-2010) summarised rainfall data obtained from Yirga Alem meteorological station, the total average annual rainfall in the area is 1240.4 mm (**Table 8-4**). The highest mean monthly rainfall occurs in May with 161 mm and remains above 100 mm through the summer months. The wettest months occur between March and October and the driest months occur during November to February.

Table 8-4: Monthly Average Annual Rainfall (mm) for the period 1981 – 2010 (Yirga Alem Station)

Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean Annual
Yirga Alem	28.0	51.2	10.48	174.8	161.4	111.8	102.8	125.7	155.6	149.2	43.5	31.6	1240.4

Rainfall data for the Dilla (RTC site) was obtained from the Dilla meteorological station and was chosen to represent the site due to the proximity. Based on summarised rainfall data obtained from the Dilla meteorological station, covering a period of more than 50 years (1954-2010), the mean annual rainfall in the area is 1319 mm (**Table 8-4**). The highest recorded rainfall over the period was recorded in 1958 with total annual rainfall of 1755 mm. The lowest rainfall recorded over the period was in 1961 with a total annual rainfall of 960 mm. The wettest months occur between March and October and the driest months occur during November to February.

Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean Annual
Dilla	41	42.9	104	194	182	118	106	109	152	162	72	36.1	1319

8.2.3 EXISTING AIR POLLUTION SOURCES

Potential sources of emission surrounding the proposed site include:

- Vehicle entrainment on unpaved roads;
- Vehicle tailpipe emissions;
- Domestic fuel burning; and
- Agricultural activities.

VEHICLE ENTRAINMENT ON UNPAVED ROADS

Vehicle-entrained dust emissions from the unpaved roads potentially represent a significant source of fugitive dust. When a vehicle travels on an unpaved road, the force of the wheels on the road surface causes the pulverisation of surface material. Particles are lifted and dropped from the rolling wheels, and the road surface is exposed to strong air currents in turbulent shear with the surface. The turbulent wake behind the vehicle continues to act on the road surface after the vehicle has passed (USEPA, 2006).

The quantity of dust emissions from a given segment of unpaved road varies linearly with the volume of traffic. Emissions depend on source parameters that characterise the condition of a particular road and the associated vehicle traffic. Dust emissions from unpaved roads have been found to vary directly with the fraction of silt in the road surface materials. Other parameters include vehicle speeds, mean vehicle weight, average number of wheels per vehicle and road surface moisture. Although vehicle entrainment on unpaved roads has been found to result in high fugitive dust emissions, these impacts are often limited to close to the source (USEPA, 2006).

VEHICLE TAILPIPE EMISSIONS

Atmospheric pollutants emitted from vehicles include hydrocarbons, CO, CO_2, NO_x, SO_2 and particulates. These pollutants are emitted from the tailpipe, from the engine and fuel supply system, and from brake linings, clutch plates and tyres. Hydrocarbon emissions, such as benzene, result from the incomplete combustion of fuel molecules in the engine. Carbon monoxide is a product of incomplete combustion and occurs when carbon in the fuel is only partially oxidized to carbon dioxide. Nitrogen oxides are formed by the reaction of nitrogen and oxygen under high pressure and temperature conditions in the engine. Sulphur dioxide is emitted due to the high sulphur content of the fuel. Particulates such as lead originate from the combustion process as well as from brake and clutch linings wear (Samaras and Sorensen, 1999).

DOMESTIC FUEL BURNING

Pollutants released from these fuels include CO, NO_2, SO_2, inhalable particulates and polycyclic aromatic hydrocarbons. Particulates are the dominant pollutant emitted from the burning of wood. Smoke from wood burning contains respirable particles that are small enough in diameter to enter and deposit in the lungs. These particles comprise a mixture of inorganic and organic substances including aromatic hydrocarbon compounds, trace metals, nitrates and sulphates. Polycyclic aromatic hydrocarbons are produced as a result of incomplete combustion and are potentially carcinogenic in wood smoke (Maroni et al., 1995). The main pollutants emitted from the combustion of paraffin are NO_2, particulates, carbon monoxide and polycyclic aromatic hydrocarbons.

Domestic fuel burning shows a characteristic diurnal and seasonal signature. Periods of elevated domestic fuel burning, and hence emissions, occurs in the early morning and evening for space heating and cooking purposes. During the winter months, an increase in domestic fuel burning is recorded as the demand for space heating and cooking increases with the declining temperature.

A national survey conducted by the Central Statistical Agency in 2011 indicated that biomass fuel (solid fuel) is used by nearly all Ethiopian households (95%), with the vast majority (85%) using firewood for cooking (**Table 8-5**). The household fuel use pattern is mixed, in that more than one type of fuel can be used in a household. With respect to the main source of energy, however, the pattern varies between rural and urban settings. For instance, firewood is used by nine out of ten rural

households as the main fuel source for cooking, while slightly more than half (54%) of urban household dwellers use wood (CSA, 2011).

Charcoal is the second most frequently used type of fuel (17.5%) in urban areas, although it is used infrequently (0.2%) as fuel in rural areas, with the remainder of rural households (8.4%) using leaves/dung cakes. The use of relatively cleaner energy sources such as kerosene, LPG, and electricity for cooking is almost non-existent in rural settings, whereas in urban areas kerosene (5%) and gas/electricity (7.7%) are used in small proportions. Kerosene is used, however, for lighting in urban (88%) and rural (64.4%) households (CSA, 2011).

Table 8-5: Household energy use for cooking in Ethiopia (CSA, 2011).

Fuel Used for Cooking	Country (%)	Urban (%)	Rural (%)
Wood	85	63.3	90.8
Leaves / Crop Residue / Animal Dung	7.2	2.7	8.4
Charcoal	3.9	17.5	0.2
Solid Fuel	95	87.4	99.6
Kerosene	1.2	4.9	0.2
LPG / Electricity	1.9	7.7	0.2

AGRICULTURAL ACTIVITIES

Emissions from agricultural activities are difficult to control due to the seasonality of emissions and the large surface area producing emissions (USEPA, 1995). Expected emission resulting from agricultural activities include particulates associated with wind erosion and burning of crop residue, chemicals associated with crop spraying and odiferous emissions resulting from manure, fertilizer and crop residue.

Dust associated with agricultural practices may contain seeds, pollen and plant tissue, as well as agrochemicals, such as pesticides although the use of pesticides is believed to be limited. The application of pesticides during temperature inversions increases the drift of the spray and the area of impact. Dust entrainment from vehicles travelling on gravel roads may also cause increased particulates in an area. Dust from traffic on gravel roads increases with higher vehicle speeds, more vehicles and lower moisture conditions.

Agricultural activities in the area include farming of cereals, coffee, fruits, vegetables, dairy and meat and other animal products. Large portions of the proposed site include open grassland used for grazing with portions of the land containing dwellings and associated crop farming practices and plantations, predominantly Eucalyptus (WSP, 2017).

8.3 TOPOGRAPHY AND GEOMORPHOLOGY

8.3.1 YIRGA ALEM IAIP

A detailed topography survey was carried out by MACE during September and October 2016. In general the topography of the site varies between +1768.193 m to +1727.793 m with undulations at some portions of the site, gently sloping from the centre of the site towards the North, Southwest and Southeast directions. The proposed IAIP masterplan layout, showing the survey contour lines and predominant slope, within the site boundary is shown in **Figure 8-1**.

The Gidabo River Basin is located in this region and resulted from the collapse of the rift which took place in a fairly regular, single block formation. As a result the typical rift morphology which is well development, there are three clearly visible major physiographic regions, that is, the rift floor, escarpment (where the project site is located) and the highland. The major tectonic scarp connects

the rift floor with the uplifted plateau; the plateau rises to elevations of 3200 metres above sea level (masl), whereas the rift floor descends regularly into the Lake Abaya, where it lies at 1175 masl. An average elevation of the project site is 1740 masl which is on a transition between the rift floor and the highland.

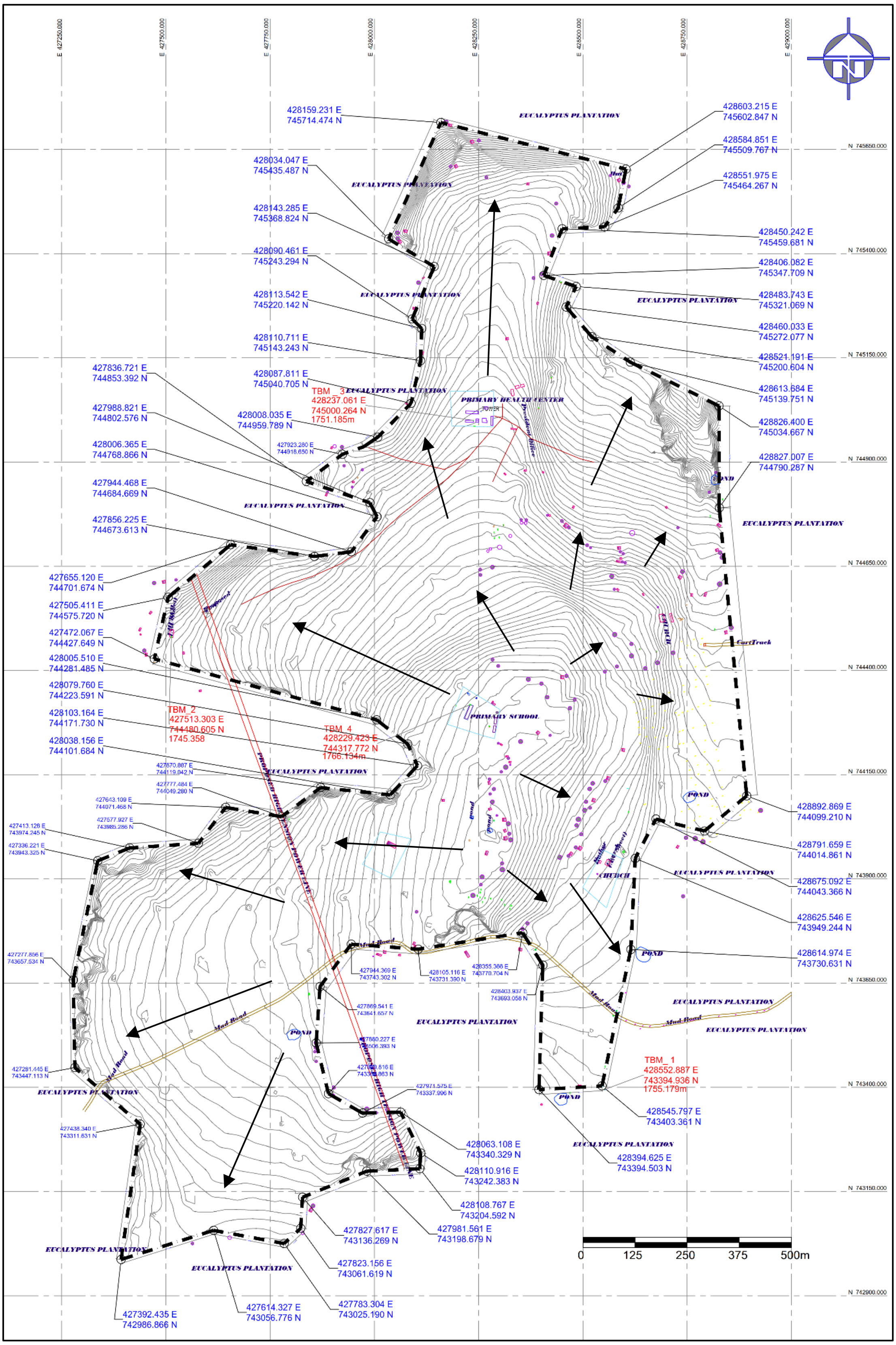

Figure 8-1: Topography survey drawing of the IAIP site indicating predominate slope (Source: MACE)

The drainage system of the basin is strongly influenced by the morphology, which in turn is dependent on the geological phenomena. The area including the project site is drained by Gidabo River which is the second largest river flowing to Lake Abaya, the largest lake in the Ethiopian rift, with a 3302 km^2 drainage area, which extends from the centre of the rift floor to the mountains of the rift boundary.

Significant areas of erosion are evident directly adjacent to the site, predominantly along the western boundary, as well as less extensive areas within the site boundary. The IAIP site boundary has been broadly determined by the presence of steep eroded gulley’s that would not be suitable for development and have therefore been avoided and remain outside the proposed compound.

8.3.2 DILLA RTC

A detailed topography survey was carried out by MACE during September 2016. In general the topography of the site varies between +1544.500 m to +1519.500 m with undulations at some portions of the site, gently sloping from the southeast to northwest. The topographical survey only provides detailed contours for the identified site, however based on the undulating topography in the area and that the site extends up a sloped section the site will be highly visible from areas to the North and West of the site. The proposed RTC masterplan layout, showing the survey contour lines and predominant slope, within the site boundary is shown in **Figure 8-2**.

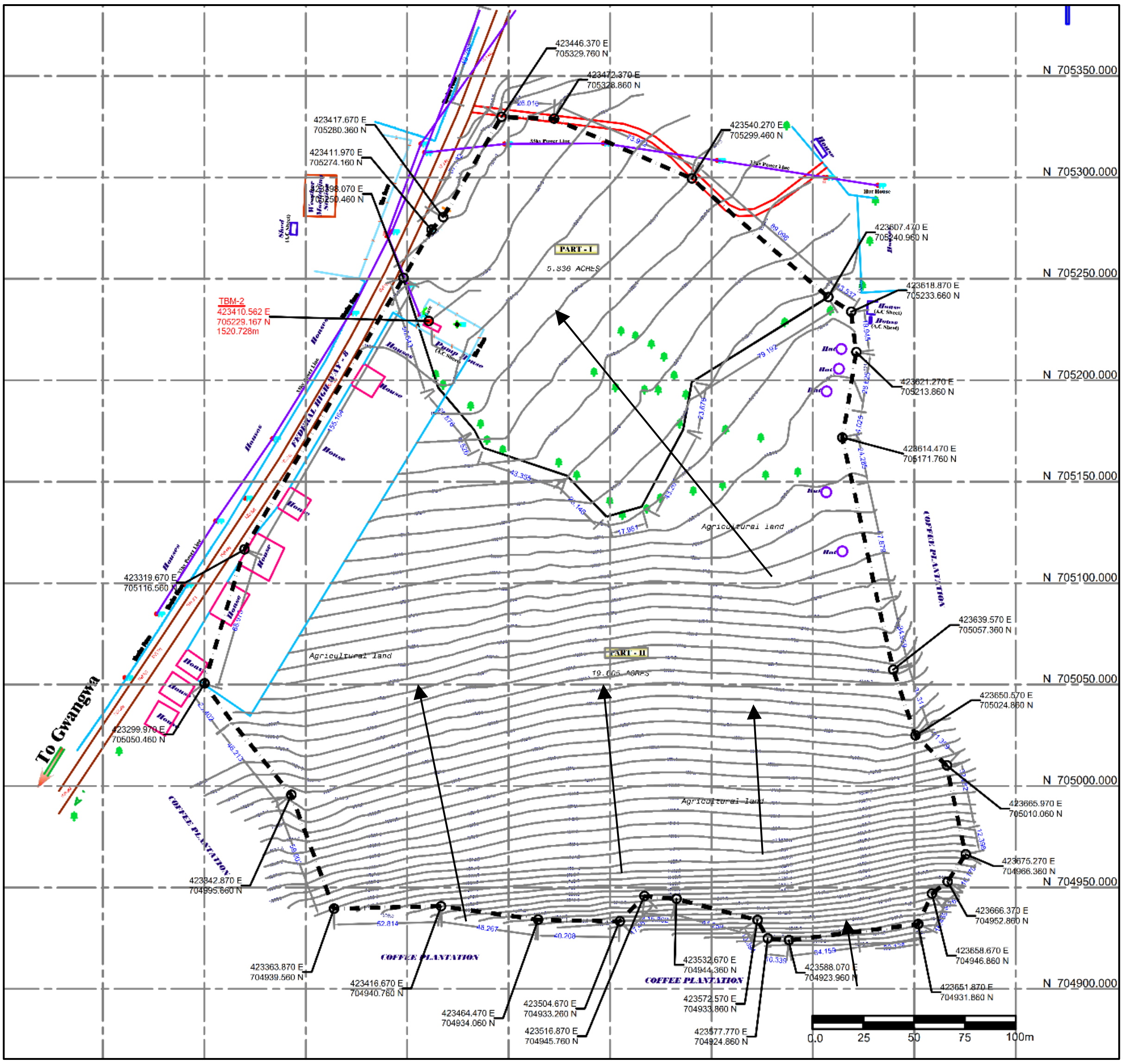

Figure 8-2: Topography survey drawing of the RTC site indicating predominate slope (Source: MACE)

8.4 GEOLOGY

8.4.1 YIRGA ALEM IAIP

The volcanic sequences and sediments in the area are densely dissected by extensional fault systems resulting from the rifting process. The major fault types are normal faults having generally similar strike but some dip to the east and others to the west. Chronologically they can be grouped into two distinct fault systems. The older, Oligocene-Miocene, NE-SW trending fault system which characterises mainly the rift margin and the younger, Quaternary-present, NNESSW trending set of faults affecting the rift floor, usually referred to as the Wonji fault belt (WFB).

Figure 8-3 shows a schematic geological map of the study basin.

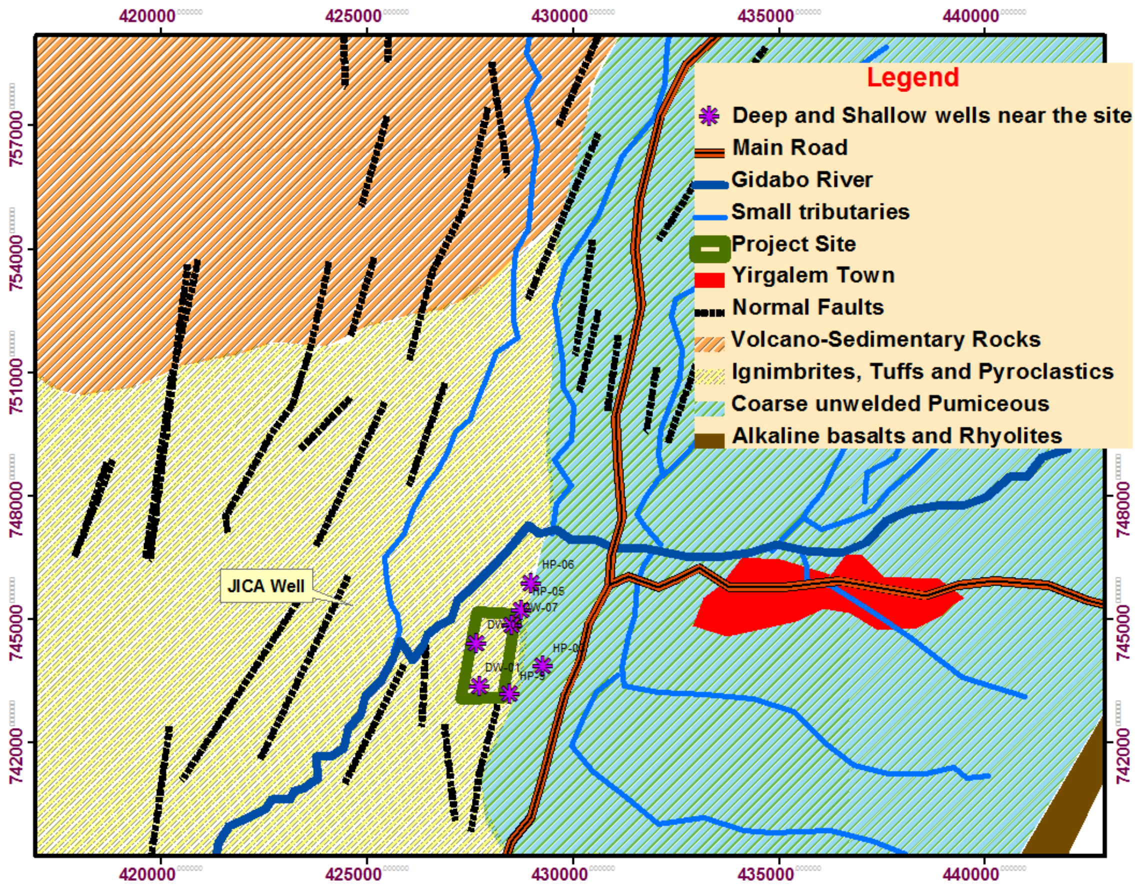

Figure 8-3: Geological Map of the Yirga Alem Area (modified from Geological Map of Dilla Sheet)

Brief descriptions of the stratigraphy and geochronology of the deposits indicated on the map are provided below, starting from the oldest unit.

BASALT AND RHYOLITES

This is an older volcanic unit, occurring in south eastern tip of the area. The Basalt is characterised by thick, extensive lava flows that locally shows columnar jointing and high weathering intercalated with rhyolites and ignimbrites.

IGNIMBRITES

This lithic fresh Ignimbrite exposed in south-eastern part of the area shows light grey to grey colour the weathered colour is light brown. Most of it contains rhyolitic and trachytic rock fragments with fine

and compacted ground mass. It makes columnar joints. The fresh rhyolite shows pink colour, medium to coarse grains and slight to high weathering.

PUMICEUS PYROCLASTICS

This quaternary volcanic rock is the intercalation of diatomites and ignimbrites and it is exposed widely on the eastern part of the area including Yirga Alem Town. The diatomite is light yellow to white in colour. It is fine grained and has 30m thickness. Minor fossils are found within this unit. Most of the pyroclasts have pumice fragments in fine grained material. The diatomite is light friable or loose with light grey to yellow colour.

IGNIMBRITES, TUFFS AND PYROCLASTICS

The unit covers the project site and western side of the area. It contains light grey, coarse grained lithic ignimbrites, unwelded tuffs which have a light grey colour exposed by making flat land, and pyroclasts.

VOLCANO CLASTIC SEDIMENTS AND TUFFS

This lithological unit is exposed on the north western part of the project site. Most of the lacustrine sediments and the volcanoclastic sediments are light yellow coloured with medium grain size. The rock units include aphyric basalts, scoraceous basalts, ignimbrites, unwelded tuffs, volcano sediments and lacustrine sediments. The dominant exposures are volcano sediments and tuffs.

8.4.2 DILLA RTC

Being situated in the Ethiopian Rift, the geological cover of the study area (**Figure 8-4**) is the product of a series of volcanic eruptions since the Miocene (WoldeGabriel et al., 1990). In general, the rocks covering the area fall into three major groups: pre-rift volcanic rocks, rift volcanic rocks and post rift sediments. The most important features of these rocks together with the geological structure are compiled from current and previous studies (WoldeGabriel et al., 1990; Boccaletti et al., 1998; Acocella et al., 2003; Korme et al., 2004; Kurz et al., 2007; Mechal, 2007; Halcrow, 2008; GSE, 2012) and summarised below from the oldest to the youngest.

IGNIMBRITE, RHYOLITE AND TRACHYTE

This unit widely stretches from north to south on western side of the Dilla Town including the project site. It is a thick succession of stratoid silicics comprising predominantly ignimbrites with subordinate unwelded tuffs, ash flows, rhyolites and trachytes, which is commonly known as the Nazreth group form parts of the rift floor and also outcrops in the escarpment and highland. This lithic fresh Ignimbrite exposed in southeast part of the area shows light grey to grey colour the weathered colour is light brown. Most of it contains rhyolitic and trachytic rock fragments with fine and compacted ground mass. It makes columnar joints. The fresh rhyolite shows pink colour, medium to coarse grains and slight to high weathering.

APHYRIC AND PORPHYRITIC BASALT

This unit covers wide part of western side of the area. The porphyritic basalt is olivine-pyroxene phyric which has a fresh dark grey colour and shows slight to medium weathering. When weathered it shows light grey to light brown colour. The lesser vesicular basalt is a brown coloured medium to highly weathered and it forms cliffs.

VOLCANO CLASTIC SEDIMENTS AND TUFFS

This lithological unit is exposed on the north western part of the project site. Most of the lacustrine sediments and the volcanoclastic sediments are light yellow coloured with medium grain size. The rock units include aphyric basalts, scoraceous basalts, ignimbrites, unwelded tuffs, volcano sediments and lacustrine sediments. The dominant exposures are volcano sediments and tuffs.

GEOLOGICAL STRUCTURE OF THE AREA

The volcanic sequences and sediments in the area are densely dissected by extensional fault systems resulting from the rifting process. The major fault types are normal faults having generally similar strike with NE-SW trending fault system which characterises mainly the rift margin as indicated in **Figure 8-4**.

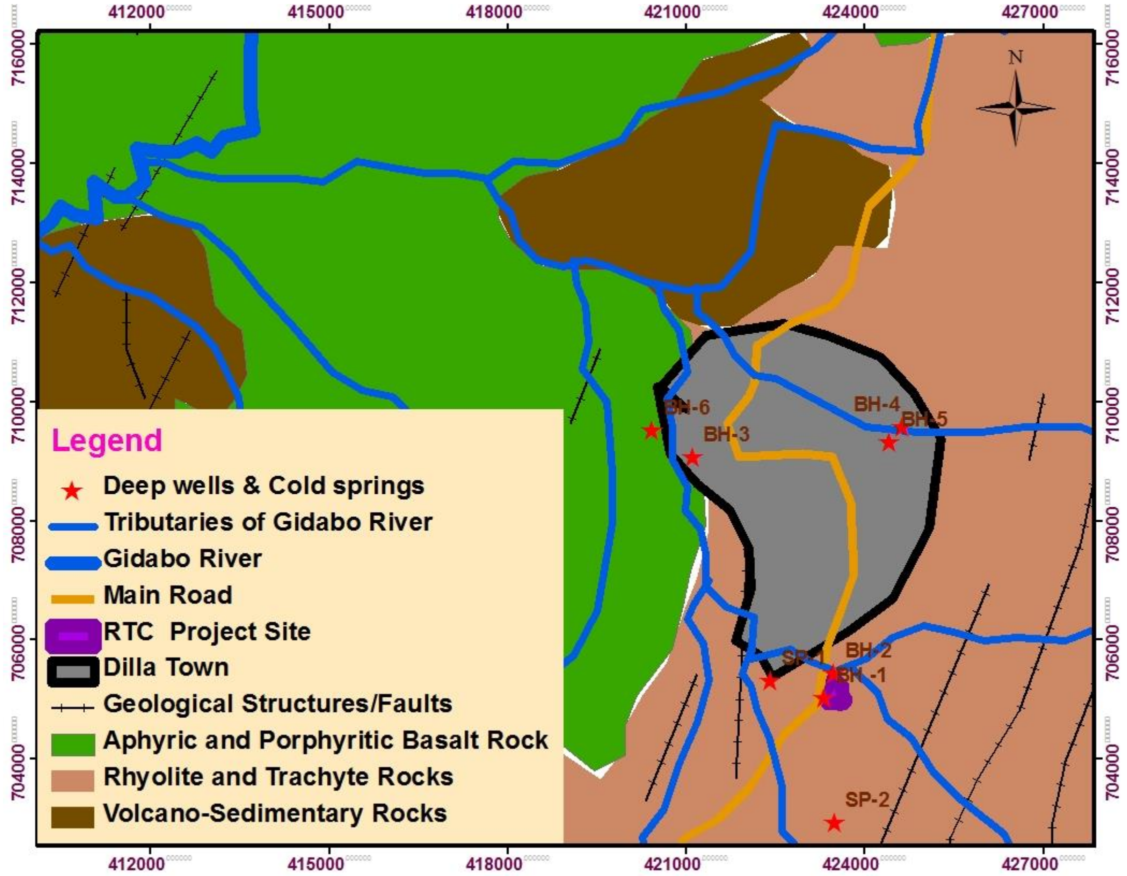

Figure 8-4: Geological Map of Dilla Area (modified from Geological Map of Dilla Sheet)

8.5 SOILS

A detailed desktop assessment was undertaken for the SNNP IAIP and RTC sites. This included assessing the ISRIC World Soils Database, based on the World Reference Base Classification System (WRB, 2006) in order to establish the soil types according to an international standard system. Information associated with the outcomes of the ISRIC world soils database outcomes was reviewed, as was general information associated with Ethiopian soils, and, specifically, those found in the SNNP region.

8.5.1 SITE ASSESSMENT

Site visits were conducted from 14 to 16 August 2017 at the SNNP IAIP and RTC sites. Soil survey, classification, field mapping and sample analysis were undertaken. Six soil samples were taken at the IAIP site and two soil samples were taken at the RTC site. The following steps were performed:

1. Survey of the study area was undertaken on foot, using a hand-held bucket auger to identify soil forms present. Current activities at the site were also noted, and specific areas of land use and infrastructure were noted.

2. Auger points were assessed to a depth of approximately 1.5m for classification purposes, roughly according to a pre-determined set of points (see **Figure 8-5** and **Figure 8-6**) drawn along zig-zagged transects. Free survey was undertaken using the points as a guideline.
3. A hand-held GPS was used to record the location of each auger point.
4. Soil forms were described in the field according to local soil characteristics (with assistance from local partners), the World Reference Base classification system (WRB, 2006) and the South African Soil Classification Taxonomic System (Soil Classification Working Group, 1991), published as a Memoir on the Agricultural Natural Resources of South Africa No.15;
5. Representative soil samples were collected and submitted to Jones Laboratory in Wales for analysis. Samples were analysed for Total Nitrogen, Calcium, Magnesium, Potassium, Copper, Iron, Aluminium, Manganese, Molybdenum, Zinc, Phosphorus, Boron, Total Sulphur, soluble Chloride, pH, Total Organic Carbon, Available Phosphorus and pH. The particle size distribution was also determined (results are pending); and
6. The typical land uses and their associated soils were investigated for the SNNP region and the land uses identified on site were noted and mapped.

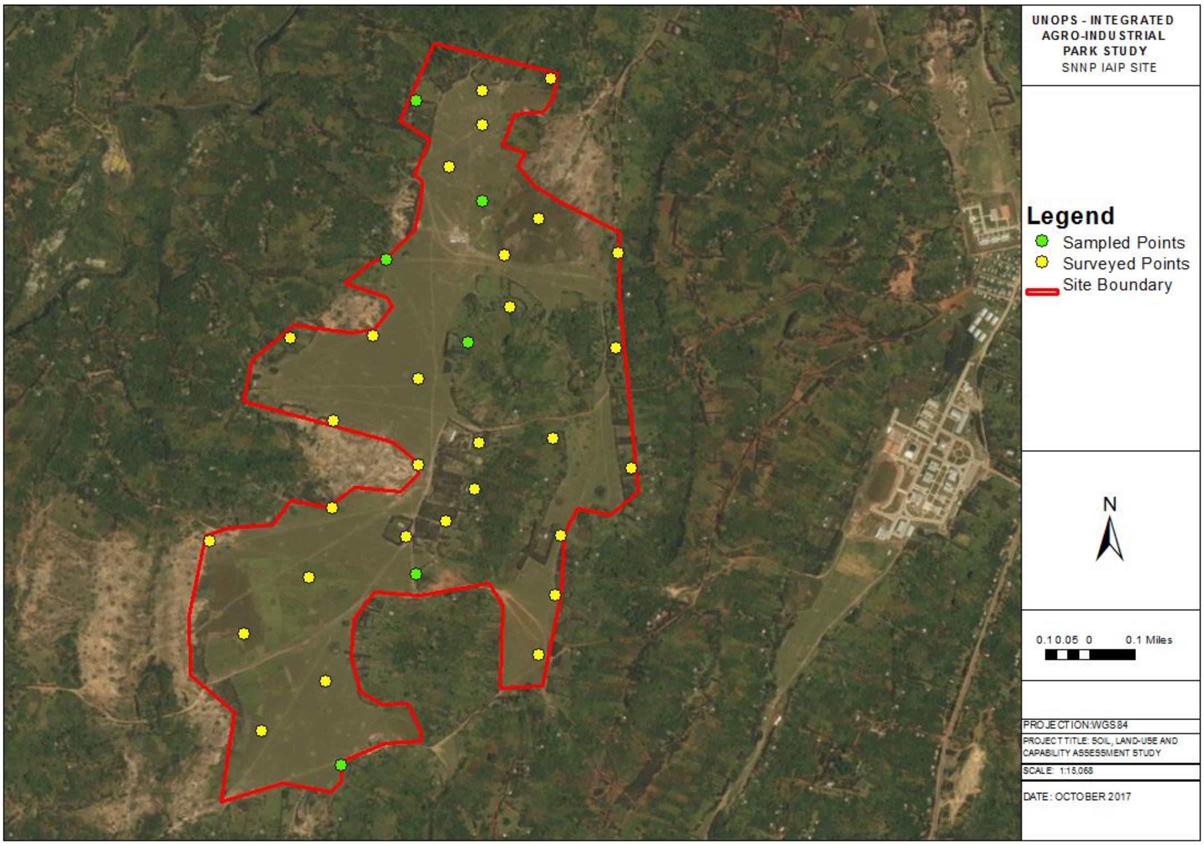

Figure 8-5 : Soil assessment sampling locations across the Yirga Alem IAIP site

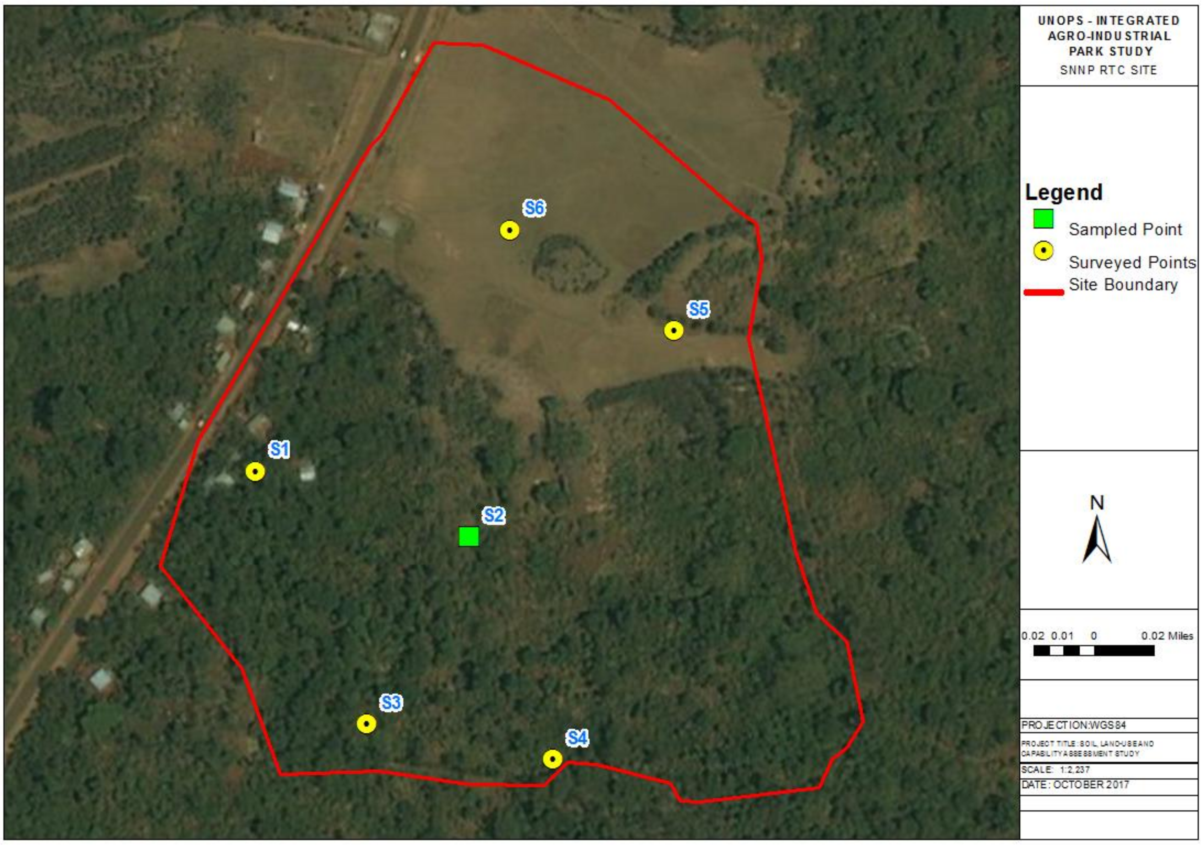

Figure 8-6: Soil sampling locations across the Dilla RTC Site

8.5.2 SOIL CLASSIFICATION

WORLD REFERENCE BASE CLASSIFICATION SYSTEM

The World Reference Base for Soil Resources (WRB, 2006) is the international standard taxonomic soil classification system endorsed by the International Union of Soil Sciences (IUSS). It was developed by an international collaboration coordinated by the International Soil Reference and Information Centre (ISRIC) and sponsored by the IUSS and the FAO via its Land & Water Development division. It replaces the previous FAO soil classification. The WRB borrows heavily from modern soil classification concepts, including USDA soil taxonomy, the legend for the FAO Soil Map of the World 1988, the *Référentiel Pédologique* and Russian concepts. The classification is based mainly on soil morphology as an expression of pedogenesis. A major characteristic the USDA soil taxonomy system is that climate is not part of the system, except insofar as climate influences soil profile characteristics. As far as possible, diagnostic criteria match those of existing systems, so that correlation with national and previous international systems is as straightforward as possible. The WRB is meant for correlation of national and local systems.

ETHIOPIAN CLASSIFICATION SYSTEM

No Ethiopian classification system was identified through local partners, local university enquiries and literature searches. Soils papers published in Ethiopian journals utilise the FAO or WRB classification system (depending on when they were written) as these systems are widely used throughout Ethiopia (Assefa, 2002; Mishra *et al.*, 2004; Ayalew, 2015).

SOUTH AFRICAN CLASSIFICATION SYSTEM

The soils identified in the field were classified by form in accordance with the South African soil taxonomic system (Soil Classification Working Group, 1991) as a great deal of information is available about the various South African soil forms. In this way, more information could be given about the

characteristics of the types of soils identified in the field. All South African soil forms fall within 12 soil types; Duplex (marked accumulation of clay in the B horizon), Humic (intensely weathered, low base status, exceptional humus accumulation), Vertic (swelling, cracking, high activity clay), Melanic (dark, structured, high base status), Silicic (Silica precipitates as a dorbank horizon), Calcic (accumulation of limestone as a horizon), Organic (peaty soils where water inhibits organic breakdown), Podzolic (humic layer forms beneath an Ae or E), Plinthic (fluctuating water table causes iron re-precipitation as ferricrete), Oxidic (iron oxides weather and colour soils), Hydromorphic (reduced lower horizons) and Inceptic (young soils - accumulation of unconsolidated material, rocky B or disturbed) soils.

SOIL CAPABILITY ASSESSMENT

The area's soils capability was assessed and mapped, based on the results of the classification study and the sample results. The South African land capability classification system by Scotney *et al*. (1987) was used to identify and map land capability and soil potential (**Table 8-6**). This system is useful in that it is able to quickly give one an overview of the agricultural capability and limitations of the soils in question, and is useful for soil capability comparisons. Criticisms of this system, however, include its lack of consideration of the local setting, land use planning and a lack of financial resources (Nethononda *et al.*, 2014). For this reason the site's soil capability has also been assessed taking the local setting into account.

Table 8-6: Land Capability Classification System (Scotney *et al.*, 2014)

Land Capability Group	Land Capability Class	Increased intensity of use									Limitations
Arable	I	W	F	LG	MG	IG	LC	MC	IC	VIC	No or few limitations. Very high arable potential. Very low erosion hazard
	II	W	F	LG	MG	IG	LC	MC	IC	-	Slight limitations. High arable potential. Low erosion hazard
	III	W	F	LG	MG	IG	LC	MC	-	-	Moderate limitations. Some erosion hazards
	IV	W	F	LG	MG	IG	LC	-	-	-	Severe limitations. Low arable potential. High erosion hazard.
Grazing	V	W	-	LG	MG	-	-	-	-	-	Water course and land with wetness limitations
	VI	W	F	LG	MG	-	-	-	-	-	Limitations preclude cultivation. Suitable for perennial vegetation
	VII	W	F	LG	-	-	-	-	-	-	Very severe limitations. Suitable only for natural vegetation
Wildlife	VIII	W	-	-	-	-	-	-	-	-	Extremely severe limitations. Not suitable for grazing or afforestation.

W - Wildlife
F - Forestry
LG - Light grazing
MG – Moderate grazing
IG - Intensive grazing
LC - Light cultivation
MC - Moderate cultivation
IC - Intensive cultivation.
VIC – Very intensive cultivation

8.5.3 REGIONAL OVERVIEW

According to the World Reference Base for Soil Resources (WRB, 2006), the soils of Ethiopia can be classified into five principal types, as shown in **Table 8-7**.

Table 8-7: Soils of Ethiopia

Soil Type	Composition and Description
1	The first type is composed of Nitosols and Andosols and is found on portions of the Western and Eastern highlands. These soils are formed from volcanic material and, with proper management, have medium to high potential for rain-fed agriculture.

Soil Type	Composition and Description
2	The second group of soils; Cambisols and Luvisols, are found in the Simien plateau of the Western Highlands. They are highly weathered with a subsurface accumulation of clay and are characterized by low nutrient retention, surface crusting, and erosion hazards. With proper management, they are of medium agricultural potential.
3	The third group of soils is the dark clay found in the Western Lowlands and at the foothills of the Western Highlands. Composed of Vertisols, they have medium to high potential for both food and agriculture but pose tillage problems because they harden when dry and become sticky when wet. Some of the rich coffee-growing regions of Ethiopia are found on these soils.
4	The fourth group is composed of Yermosols, Xerosols and other saline soils that cover desert areas of the Eastern Lowlands and the Denakil Plain. Because of moisture deficiency and coarse texture, they lack potential for rain-fed agriculture. However, the wetter margins are excellent for livestock, and even the drier margins respond well to irrigation.
5	The fifth soil group is Lithosols found primarily in the Denakil Plain. Lack of moisture and shallow profile preclude cultivation of these soils.

Of the 25 World Reference Base/FAO soil orders, 17 exist in Ethiopia. Lithosols, Cambisols, Nitosols, Vertisols, Xerosols, Solonchaks, Fluvisols and Luvisols cover more than 80% of the country, and are the most important soils. Vertisols are very important soils in Ethiopian agriculture.

According to the WRB Reference Soil Group (2006), the SNNP Yirga Alem IAIP site soils include Luvisols, Alisols and Retisols and the SNNP Dilla RTC site is covered by Vertisols.

8.5.4 YIRGA ALEM IAIP

DESKTOP REVIEW

As mentioned, the ISRIC database shows the SNNP IAIP site to be dominated by Luvisols, Alisols and Retisols. The combination of Luvisols, Alisols and Retisols works out at an average particle size distribution over the site of 45% sand, 21% silt and 34% clay. Using the United States Department of Agriculture Soil Texture Triangle (USDA, 1939), which is widely used world-wide, the soil of the site would, on average, be classified as a Sandy Clay Loam. The mixed mineralogy, high nutrient content and good drainage of Luvisols make them suitable for a wide range of agriculture, from grains to orchards to vineyards. Luvisols form on flat or gently sloping landscapes under climatic regimes that range from cool temperate to warm Mediterranean. Luvisols are technically characterized by a surface accumulation of humus overlying an extensively leached layer that is nearly devoid of clay and iron-bearing minerals. Below the latter lies a layer of mixed clay accumulation that has high levels of available nutrient ions comprising calcium, magnesium, sodium, or potassium. These soils often differ from other types of soils in the amount of Ca (calcium) present in the parent material (Williams, 1990) (Ebelhar et al, 2016). Retisols are similar to Luvisols in that they have a clay illuviation horizon, but also contain a bleached, coarser-textured soil material into the illuviation horizon forming a net-like pattern (FAO, 1998). Alisols are strongly acid, generally unproductive soils, with accumulated high activity clays in their subsoils. Al (Aluminium) dominates the exchange complex (FAO, 2001). Alisols are poorly drained soils with a dense subsurface clay layer, which causes a relatively high concentration of aluminum ions in the root zone and occur mainly in tropical and humid subtropical climates. Their high acidity is increased by limited drainage and they thus need significant liming. They contain few nutrients and therefore need fertilizer, and do not have much surface coherence so are easily eroded. Aluminium and manganese toxicity is a very serious problem in Alisols, because at the low pH of these soils such generally insoluble metals become soluble and can poison plants which are not tolerant of them. Oil palm, cotton, and maize are crops suitable to be grown on Alisols, though most crops require very intensive fertilisation for long-term success (Dahlgren *et al*., 2016).

LAND USE ASSESSMENT

For the 2004-2005 period, 100,338 tons of coffee were produced in the general SNNP region, based on inspection records from the Ethiopian Coffee and Tea authority. This represented 44.2% of the total production in Ethiopia. Farmers in the region had an estimated total 7,938,490 head of cattle (representing 20.5% of Ethiopia's total cattle), 3,270,200 sheep (18.8%), 2,289,970 goats (17.6%), 298,720 horses (19.7%), 63,460 mules (43.1%), 278,440 donkeys (11.1%), 6,586,140 poultry of all species (21.3%), and 726,960 beehives (16.7%) (CSA, 2005).

At the SNNP Yiga Alem IAIP site, 63ha or 30% of the area is currently used for residential dwellings and associated subsistence agriculture, and 153ha or 70% of the site is grassland. This distribution of land uses can be seen in **Figure 8-7**.

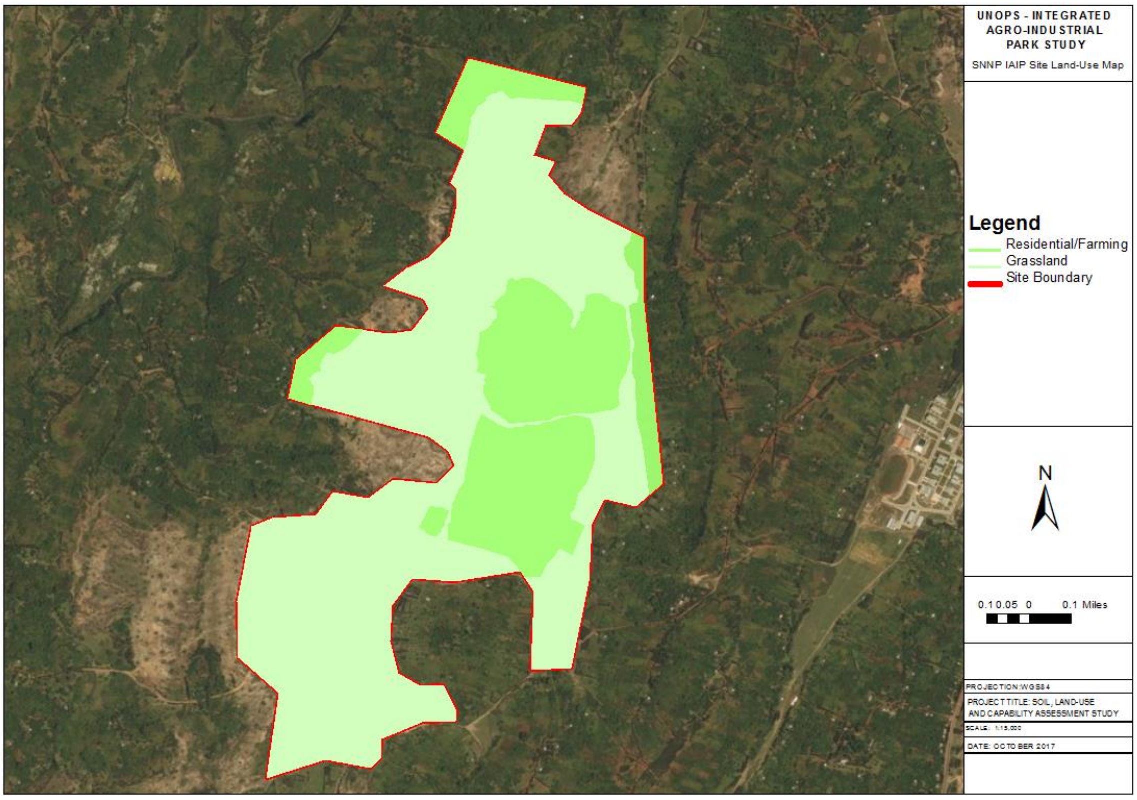

Figure 8-7: Distribution of land uses at Yirga Alem IAIP site

SOIL CLASSIFICATION

At the SNNP Yiga Alem IAIP site, the Arcadia soil form was identified over 11ha or 5% of the site, Shortlands (Oxidic) soils were identified over 205ha or 95% of the site, and Westleigh (Plinthic) soils were identified over 1.2ha or 0.6% of the site. This distribution of soil classifications can be seen in **Figure 8-8**.

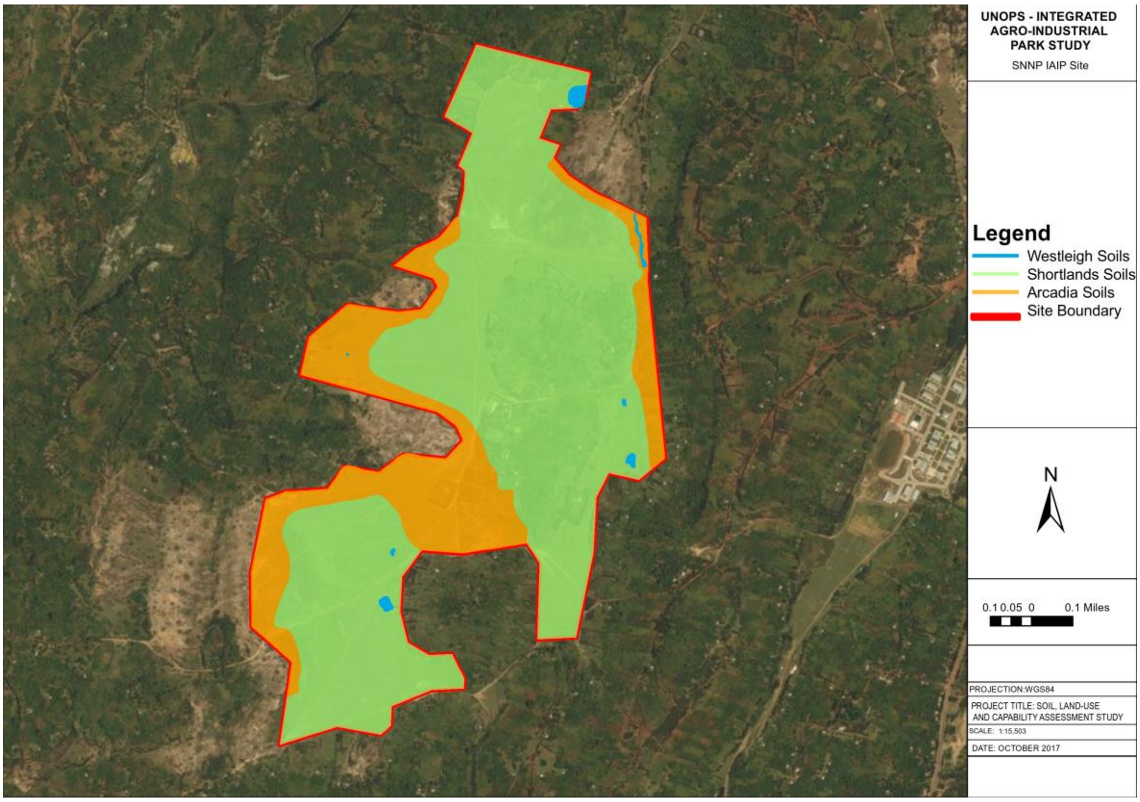

Figure 8-8: Soils Classification and distribution across the SNNP Yirga Alem IAIP site

WITBANK / ANTHROSOL SOILS

In most soil classification systems, a soil name exists to describe soils that have been modified such that they do not resemble their original soil type. These soils can include those that have been used for agriculture where ploughing has modified the soil. For the purposes of this study, where previously ploughed soils are clearly identifiable (and ploughing is generally not deep in the area), these have been treated as their original soil type, so, while some of the soils identified could technically be classified as modified soils, the original soil forms could always be identified, so were used instead to make the outcomes of the study more useful. In the South African soil classification system, the closest soil form to a type of soil that has been formed or heavily modified due to long-term human activity is called a Witbank, which is an Orthic A horizon over man-made deposits. An Anthrosol in the World Reference Base for Soil Resources is a type of soil that has been formed or heavily modified due to long-term human activity, such as from irrigation, addition of organic waste or wet-field cultivation used to create paddy fields. Such soils can be formed from any parent soil, and are commonly found in areas where agriculture has been practised for centuries. Anthrosols can be found worldwide. The Witbank and Anthrosol soils thus both describe soils that have been modified through anthropogenic processes.

ARCADIA / VERTISOL SOILS

Using the South African soils taxonomic system of classification (Soil Classification Working Group, 1991), the Arcadia soil form was identified over 11ha or 5% of the IAIP site (see **Figure 8-8**). This soil is characterised by a Vertic A horizon over unspecified lower horizons. During the soil survey, there was strong evidence of typical Vertic A horizon cracking (see photograph in **Figure 8-9**). The Arcadia soil group falls into the South African Vertic soil group owing to its shrink-swell clay properties. Using the WRB classification system, the soils could be described as Vertisols. These are soils in which there is a high content of expansive clay known as montmorillonite that forms deep cracks in drier seasons or years. Vertic and Vertisol soils clearly describe the same type of soils.

Figure 8-9: Photograph showing Arcadia / Vertisol surface cracking – SNNP IAIP site

SHORTLANDS/LUVISOL SOILS

Soils that could be described as Shortlands (Oxidic) soils in the South African classification system were identified over 205ha or 95% of the IAIP site (see **Figure 8-8**). This soil is characterised by an Orthic A horizon over a red structured B horizon. The photograph in **Figure 8-10** was taken during the soil survey, and indicates the horizons from the top of the picture (the upper layer is the Orthic A, followed by the red structured B horizon). It is important to highlight that the soils appeared redder on site than they appear in the photograph. Oxidic soils are characterised by iron enrichment. Some, more clay-rich Shortlands soils can be difficult to distinguish from members of the Vertic soil group (Fey, 2012). Shortlands soils can be considered similar to Luvisols.

Figure 8-10: Photograph showing Shortlands / Luvisol soil profile – SNNP IAIP site

WESTLEIGH/PLINTHOSOL SOILS

Soils that could be described as Westleigh (Plinthic) soils in the South African classification system were identified over 1.2ha or 0.6% of the IAIP site (see **Figure 8-11**). This soil is characterised by an Orthic A horizon over a soft plinthic B horizon. Photograph 3 was taken during the soil survey, and indicates mottling (caused by a fluctuating water table) within a soil ped. Plinthic soils are found in wet areas and their presence indicates a fluctuating water table (Fey, 2010). Westleigh soils can be considered similar to Plinthosols, which are produced by a fluctuating water table and comprise an iron-rich mixture of clay minerals.

Figure 8-11: Photograph showing Westleigh / Plinthosol soil – SNNP IAIP site

SOIL FERTILITY ASSESSMENT

The productive capacity of soils depends on often complex and sometimes little understood interactions between the biological, chemical and physical properties of soil (Johnston, 2011). Soil fertility is found mostly in topsoil, however the contribution the subsoil makes should not be ignored. The fertility of the total volume of soil in which the plant roots develop should be taken into account (FSSA, 2011). According to Johnston (2011), soil analysis is an aid to managing soil nutrients efficiently to maintain soil fertility for those nutrients like Phosphorus (P), Potassium (K) and Magnesium (Mg) that are retained in soil in plant-available forms. If the amount of any of these nutrients in such forms in soil is too small then yield is jeopardised, but increasing reserves in agricultural soils to very high levels is an unnecessary expense. The laboratory results of the levels of various nutrients analysed-for in the SNNP IAIP soils are shown in **Table 8-8**. The guidelines for some nutrients are provided as values, and in some cases they are presented as narratives simply because some nutrients have limited or no contribution to soil fertility, thus their deficiencies or excess may not influence soil fertility as such.

Table 8-8: Laboratory Analysed Soil Nutrients at the SNNP IAIP Site

Parameter	Units	SNNP-S3-Horizon A	SNNP-S3-Horizon B	SNNP-S6-Horizon A	SNNP-S6-Horizon B	SNNP-S10-Horizon A	SNNP-S10-Horizon B	SNNP-S13-Horizon A	SNNP-S13-Horizon B	SNNP-S28-Horizon A	SNNP-S28-Horizon B	SNNP-S35-Horizon A	SNNP-S35-Horizon B	Soil Fertility Guideline
Antimony	mg/kg	1	3	1	2	2	3	1	1	<1	3	<1	1	*
Calcium	mg/kg	4613	5457	4724	7905	6213	6934	2688	2052	3009	7039	5733	8034	>150
Copper	mg/kg	10	8	5	10	12	15	4	7	<1	13	2	9	>0.6
Iron	mg/kg	31550	65380	31370	47770	63880	70420	44710	38640	33020	47850	42160	35650	*
Magnesium	mg/kg	1631	2617	1533	2983	2752	3144	1291	933	1174	3419	2554	2789	60 – 300
Manganese	mg/kg	1037	829	565	579	2790	6456	1359	552	819	782	5219	617	1.0 - 5.0
Molybdenum	mg/kg	1.4	1.5	1.1	0.6	0.9	0.7	3.4	2.4	1.4	0.4	0.9	0.5	*
Phosphorus	mg/kg	254	61	94	61	109	83	161	75	82	64	105	48	20-100
Potassium	mg/kg	2932	3804	2010	3091	2962	3173	1975	1502	1593	3408	2180	2288	150 -800
Sulphur as S	%	0.05	0.01	0.02	0.01	0.02	0.01	0.02	<0.01	0.01	0.01	0.02	<0.01	>7.5
Boron	mg/kg	2.04	0.9	1.26	1.39	0.86	<0.25	1.31	0.38	0.52	1.65	0.99	1.37	0.2-2
Zinc	mg/kg	84	95	62	125	120	153	119	84	81	123	149	135	>1.5
Chloride	mg/kg	26	NDP	NDP	NDP	<2	NDP	8	5	8	NDP	NDP	11	5-50
Total Organic Carbon	%	4.39	1.12	1.58	1.06	1.99	1.74	2.3	0.83	1.54	1.18	2.35	0.67	*
pH	pH units	NDP	7.03	6.62	NDP	6.32	6.72	6.64	6.54	6.66	6.8	6.79	7.85	6-8.2
Total Nitrogen	%	0.41	NDP	NDP	NDP	0.52	NDP	0.21	0.11	0.02	NDP	NDP	0.07	50 - 75
Sand	%	37.08	19.76	43.20	25.00	34.85	26.37	61.13	59.45	31.96	3.50	52.98	13.31	-
Silt	%	62.12	78.68	40.67	72.41	62.12	70.42	37.97	38.71	65.36	95.55	44.05	84.81	-
Clay	%	0.79	1.56	16.13	2.59	3.03	3.22	0.90	1.84	2.68	0.94	2.98	1.88	-

* Refers to the general guidelines which were not discussed in terms of ranges but a narrative description is provided in the main context

The various parameters associated with soil fertility are described below.

SOIL TEXTURE

Soil texture drives crop production and field management as it influences drainage, water holding capacity, aeration, susceptibility to erosion, Organic Matter content, Cation Exchange Capacity (CEC) and pH buffering capacity. Soil texture is important in the context of a soil fertility analysis as soils with a higher clay content are more chemically reactive (they have a higher CEC), so tend to be more fertile (Fey, 2010). On the northwest edges of the site, soils with a silty loam texture were observed. At the centre of the site soils with a sandy-loam texture were observed. The soils in the south of the study site comprise sandy-loam A-Horizons and silty B-horizons. These variations can be attributed to geology and anthropogenic influences. The clay content of Shortlands soils (which cover most of the IAIP site) varies greatly depending on the geology and topography (Gouws, 2012).

PH

The pH of the SNNP IAIP soils is within the desired range of 6-8.2 at all the sites sampled. As pH increases, the availability of most micronutrients decreases, except for molybdenum, which becomes more available as pH increases. Micronutrient deficiencies rarely occur when the soil pH is below 6.5.

CALCIUM

The Calcium (Ca) content in all the soil samples taken from the SNNP IAIP site is greater than the guidelines provided by Horneck *et al.* (2011). In soil fertility analysis one cannot separate Ca from Magnesium (Mg), thus and their management is similar. According to Schulte and Kelling (2004), the Ca:Mg ratio seldom limits plant growth if the soil pH is within the normal growing range. Ca deficiencies are usually found in very acidic soils. They can be corrected by liming with calcium carbonate ($CaCO_3$). Calcium is rarely deficient when soil pH is adequate.

MAGNESIUM

As indicated, Ca and Mg content in soil are interrelated and the Ca:Mg ratio seldom limits plant growth if the soil pH is within the normal growing range (Schulte and Kelling, 2004). As the guidelines for acceptable levels of Mg are between 60-300 mg/kg, the Mg content in the soil samples taken from the SNNP sight are very high.

POTASSIUM

Horneck *et al*. (2011) highlights that Potassium (K) requires the most management of the three primary cations associated with soil fertility (K, Ca and Mg). Excessive K levels may be detrimental to plants. Horneck *et al*. also highlights that very low K content can limit the growth of some plants. Guidelines provided by Horneck *et al*. indicate that a K content ranging between 150-800 mg/kg in soils are advisable. The K content in the SNNP IAIP soils exceeds these guidelines.

COPPER

A Copper (Cu) content of above 0.6 mg/kg is sufficient to support plant growth (Horneck *et al*, 2011). Copper deficiencies are rare and Cu was above the acceptable limit in the SNNP soils analysed. Lower Cu contents are observed south of the site while higher contents were detected on the northern side of the site. ARC-SGI (2015) indicates that the availability of Cu may be very low under alkaline conditions. This makes sense in the context of the SNNP IAIP site where the soil is slightly acidic and the Cu content is sufficient.

IRON

Iron (Fe) availability in the soil is related to soil's pH; more acidic soils have a higher Fe content. ARC-SGI (2015) highlights that Fe concentrations can be reduced under pH conditions between 6.5 and 8.0, and the higher the pH the greater the restriction. The SNNP site pH ranges between 6.3 and 7.9, and the Fe content is high. The Fe content in the soil is greater than 31370 mg/kg. The highest Fe content occurs toward the north-western side of the site. As described in the soil classification section, a high Fe content was expected in these soils.

MANGANESE

Manganese (Mn) deficiencies are associated with interveinal yellowing which may also be light green in appearance. Manganese toxicities typically occur under acidic conditions (Arc-SGI, 2015). There

are no specific guidelines ascribed to Mn, however the diagnosis of either deficiency or toxicity may be attributed to pH during soil testing. Mn toxicity is common in acidic soils. The soils at the SNNP IAIP site are slightly acidic, and the Mn content is high.

MOLYBDENUM

According to Horneck *et al*., Molybdenum (Mo) concentrations are too low for most laboratories to evaluate. The soils at the SNNP site contain Mo below 3.5 mg/kg in both horizons. A study undertaken by ARC-SGI in 2015 indicated that Mo deficiencies in soils seldom occur and thus their effects on plant growth is trivial.

PHOSPHORUS

Phosphorus (P) soil tests are an index of P availability described either as low, medium, high or in excess. When compared to the acceptable level of P of between 20 and 100 mg/kg, soils in the A horizon in all the sampling points are slightly above the recommended range whereas the soils in the B Horizon are within recommended levels. P is relatively immobile in soil. If phosphorus has been applied in a fertilizer band, concentrations of P may persist where the band was placed, making interpretation of soil test data difficult. High soil phosphorus combined with P movement from soil into surface waters can cause excessive growth of vegetation, damaging aquatic ecosystems. The SNNP IAIP site has a portion where cultivation activities happen, and if the application of fertilizers containing P were applied, this results may not be a true representation of natural P in the soil given the immobility of P in the soils.

SULPHUR AS S

Sulphur (S) deficiencies supress protein synthesis, and high protein crops therefore have higher sulphur requirements. S deficiencies are common in sandy soils with limited organic content (FSSA, 2011); the soils at the SNNP IAIP site contain very low organic content and consequent S deficiencies. The guidelines provided by Horneck *et al* (2011) highlight that soils with an S content greater than 7.5 mg/kg are able to support plant growth. The SNNP IAIP site S content is below the specified range at all sampling points.

BORON

Low levels of Boron (B) may limit plant growth while high concentrations may be toxic (Horneck *et al*, 2011). B content at the SNNP IAIP site soils falls within the acceptable level of between 0.2 and 2 mg/kg with a slight exceedance occurring in the northern part of the site.

TOTAL NITROGEN

Nitrogen (N) levels are dependent on the system of land use, climate, plant cover, soil microorganisms and the amount of readily decomposable carbonaceous material in the soil. Soil texture also influences the N supply rate of the soil. Soils with a high clay content supply more N than sandy soils (ARC-SGI, 2015). The SNNP IAIP site soil clay content is low, thus the Nitrogen content is also low. Soils with an N content between 0.1 to 0.12% are conducive to plant growth. The N content at the sites generally falls within the recommended range, but in some cases it was not possible to determine the Nitrogen content.

ZINC

Horneck *et al*. (2011) highlight that a Zinc (Zn) content of 1.5 mg/kg is sufficient for most plant growth. The soils at the SNNP IAIP site contain high levels of Zn when compared to the guidelines. ARC-SGI (2015) denoted that high level of P in the soil inhibit Zn uptake while high levels of N may promote Zn uptake.

CHLORIDE

Chloride is a micronutrient essential for plant development, however it is required in small quantities (Chapagain *et al.*, 2003). Horneck *et al* (2011), indicate that soils should contain a chloride content ranging from 5 to 50 mg/kg. Samples taken from the SNNP IAIP site indicate that the Chloride content within the site falls within levels that promote plant growth.

ANTIMONY

Natural concentrations of Antimony (Sb) in the environment are low. In topsoil, Sb tends to be slightly enriched. Background concentrations of Sb in soils range between 0.3 and 8.6 mg/kg (Tschan *et al*., 2011). The Sb concentrations measured at the SNNP sites for both the A and B horizons range between 1 and 3 mg/kg showing acceptable concentrations which allow for plant development. According to Tschan *et al* (2009), Sb has no known essential biological functions. Similar to other trace elements, it can be toxic at elevated concentrations, and some Sb compounds are even considered potentially carcinogenic.

TOTAL ORGANIC CARBON

Total Organic Carbon (TOC) is a measure of the overall soil health and, if measured over a long period of time, can be an indication of whether the soil quality is improving. An increased in TOC in soils often indicates an increase in N and microbiological activity. The tests undertaken for the SNNP IAIP site indicate that less than 3% TOC is present in the soils thus the soil health can be described as poor.

SOIL CAPABILITY ASSESSMENT

The soil profiles at the study site indicated a relatively uniform depth of around 1.5m at the auger points assessed. Water was sometimes encountered at the base of the profiles. Areas of Vertisols and Vertic soil tend to have a very short growing season and are used for extensive agriculture. Where irrigation water is available Vertisols can be highly productive. Large investments are required to develop and sustain irrigated agriculture in these Vertisol regions. About 20 million ha of African Vertisols and Vertic soils are found in dry semi-arid tropical climates. The growing season in these areas varies from 60 to 200 days, and under dryland conditions one or two crops can be successfully grown. Some drainage is needed during the rainy months of the year. The cost to develop sustained agriculture in dry semi-arid tropical areas is relatively low. Twenty-five percent of the Vertisol and Vertic soils area of tropical Africa occur in dry/wet semi-arid climates, where the growing season varies from 180 to 300 days. These soils occur in high rainfall areas (MAP>1000 mm per year), and a lack of drainage is a major constraint to increased agricultural production. SNNP's MAP is 1240mm. These Vertisol regions are more suited to rangeland agriculture and agroforestry, because the cost to develop these areas for sustained arable crop production is relatively high. Vertisols and Vertic soils are potentially a highly productive group of African soils. If properly managed, they could be highly productive, but are highly prone to erosion. For sustainable agriculture on Vertisols, farming systems which include effective conservation techniques need to be developed and introduced (Virmani, 2003).

Using the South African soil capability assessment guidelines (Scotney *et al*., 1987), the land capability of the Shortlands soil was established as Land Capability Class II; 'Sight limitations with high arable potential and a low erosion hazard'. Shortlands soils do not present acidity issues and are highly productive when irrigated. They are typically associated with sweet grazing (Fey, 2012). In the context of the SNNP site, however, the land capability would be better described as a Class III as it has moderate limitations owing to the lack of capital resources in the area. It is thus suitable for Wildlife, Forestry, Light Grazing, Moderate Grazing, Intensive Grazing, Light Cultivation and Moderate Cultivation.

Using the South African soil capability assessment guidelines (Scotney *et al*., 1987), the land capability of the Arcadia soils was established as Land Capability Group 'Arable Soils' and Land Capability Class IV (the lowest of the arable classes), as it has 'Severe limitations', 'Low arable potential' and a 'High erosion hazard' and can be used for (in order of increased intensity of use) 'Wildlife, Forestry, Light Grazing, Moderate Grazing, Intensive Grazing and Light Cultivation' (Table 1, Scotney *et al.*, 1987). In the context of the SNNP sites, this is accurate in that these Vertic soils do pose severe limitations to crops owing to their shrink-swell properties; the soils are often too wet or too dry and have a tendency to squash root structures. They are also highly erodible. Having said this, while, as specified above, these soils can be highly productive, suitable conservation and irrigation techniques would need to be adopted and the cost of converting such areas to sustainable agriculture is relatively high. These are thus unlikely to become highly productive soils in the SNNP context. The distribution of land capability classes at the IAIP site can be seen in **Figure 8-12**.

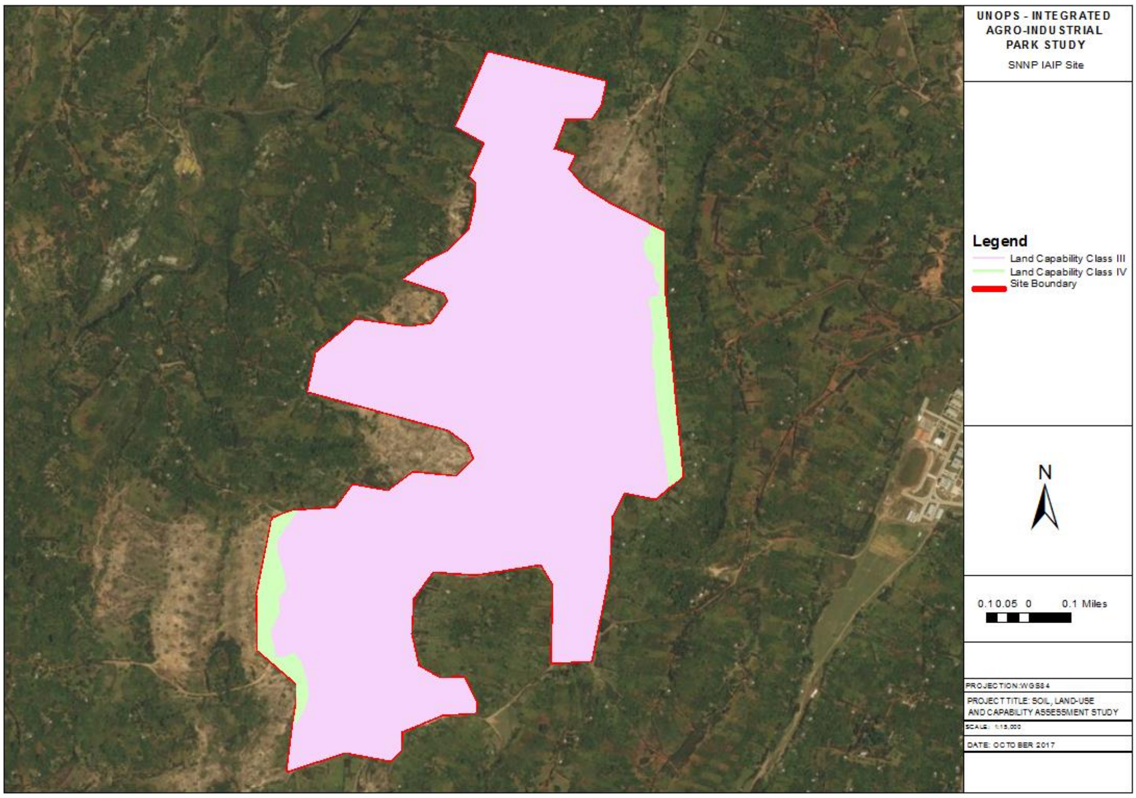

Figure 8-12: Distribution of land capability classes at the SNNP Yirga Alem IAIP site

8.5.5 DILLA RTC

DESKTOP REVIEW

As mentioned, the ISRIC database shows that the SNNP Dilla RTC site is covered by Vertisols (refer to Section 8.5.4 for description). Using the United States Department of Agriculture Soil Texture Triangle (USDA, 1939), Vertisols have an average particle size distribution of 21% sand, 24% silt and 56% clay, which works out as an average texture classification of a clay soil.

LAND USE ASSESSMENT

At the SNNP RTC site 7.5ha or 75% of the area is under mixed agricultural use, including forestry, and 2.5ha or 25% is grassland. The distribution of land use within the RTC site is shown in **Figure 8-13**.

Figure 8-13: Showing the land use at the Dilla RTC Site

SOIL CLASSIFICATION

ARCADIA / VERTIC SOILS

The Arcadia soil form (refer to Section 8.5.4 for description), was identified over 10.4ha or 100% of the SNNP RTC site (see **Figure 8-14**). Mottling was seen in some of the RTC site soils but mottled soils don't necessarily indicate wetlands. Since there are no water bodies on site and much of the site is forested area with no wetland floral species being present on site, it is highly likely that the mottling noted is indicating fluctuating wet and dry conditions as there is no evidence that these are wetland soils. There are no open water bodies on the site and no evidence of wetland flora.

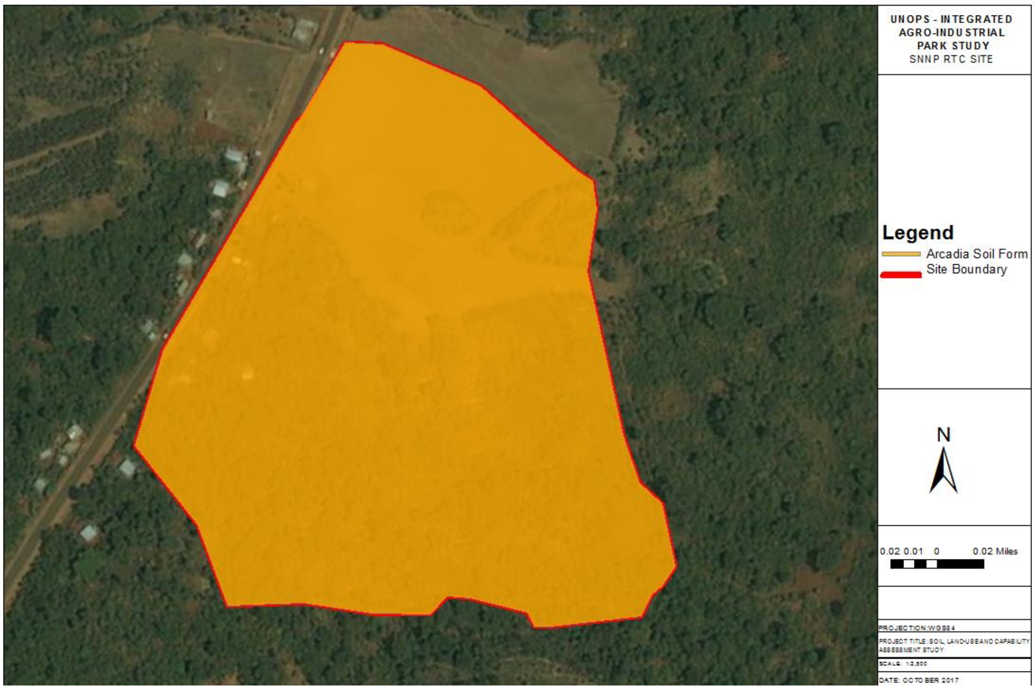

Figure 8-14: Layout showing the soil form of the Dilla RTC site.

SOIL FERTILITY ASSESSMENT

Soil analysis was also undertaken for two samples taken at the SNNP RTC site. The soil fertility results are presented in **Table 8-9** and the parameters are discussed in the subsections below. Please refer to the IAIP site section for nutrient guidelines and discussions.

Table 8-9: Laboratory Analysed Soil Nutrients at the SNNP RTC Site

Parameter	Units	Limit of Detection	SNNP-RTC-D2-Horizon A	SNNP-RTC-D2-Horizon B	Soil Fertility Guideline
Antimony	mg/kg	<1	<1	<1	*
Calcium	mg/kg	<500	1018	1003	>150
Copper	mg/kg	<1	41	7	>0.6
Iron	mg/kg	<20	13840	20120	*
Magnesium	mg/kg	<25	493	406	60 – 300
Manganese	mg/kg	<1	77	96	1.0 - 5.0
Molybdenum	mg/kg	<0.1	0.6	1.4	*
Phosphorus	mg/kg	<10	213	111	20-100
Potassium	mg/kg	<5	682	556	150 -800
Sulphur as S	%	<0.01	0.03	0.01	>7.5
Boron	mg/kg	<0.25	0.67	<0.25	0.2-2
Zinc	mg/kg	<5	27	22	>1.5
Chloride	mg/kg	<2	16	7	5-50
Total Organic Carbon	%	<0.02	8.08	2.13	*
pH	pH units	<0.01	5.84	6.26	6-8.2
Total Nitrogen	%	<0.01	0.77	0.37	50 - 75
Sand	%	<0.0	61.2	53.8	115.0
Silt	%	<0.0	37.7	45.0	82.7
Clay	%	<0.0	1.1	1.2	2.3

** Refers to the general guidelines which were not discussed in terms of ranges but a narrative description is provided in the main context*

SOIL TEXTURE

The texture of the soil analysed was a Sandy Loam. This limits the pH buffering capacity and CEC of the soil. Having said this, the soils identified over the entire site by the ISRIC database and accepted as the most likely soils to be found at the site are more shrink-swell clay-rich soils with cracked surfaces.

PH

The pH of the SNNP RTC sample A-horizon is slightly acidic at a pH of 5.84; slightly below the recommended range for plant growth. The pH of the B-horizon falls within the recommended range.

CALCIUM

The Ca content in the soil samples taken from the SNNP RTC site is higher than the recommended guidelines for optimal plant growth.

MAGNESIUM

The Mg content in the soil samples taken from the sight are high.

POTASSIUM

The K content in the SNNP RTC soil samples falls within the recommended guidelines.

COPPER

The Cu content of the samples was above the recommended limit.

IRON

The Fe content of the RTC sample site A-horizon was within the recommended range and within the B-Horizon was above the recommended range.

MOLYBDENUM

The SNNP RTC site Mo content is below 3.5 mg/kg in the two horizons, which is acceptable for plant growth.

PHOSPHOROUS

The sampled A-Horizon P levels were slightly higher than the recommended range and the B-Horizon P levels were slightly lower than the recommended range.

SULPHUR AS S

A Sulphur deficiency was identified in the soil samples taken at the SNNP RTC site. This is likely owing to the low organic content at the site.

BORON

The B content of the SNNP RTC site soils falls within the recommended range for optimal plant growth.

TOTAL NITROGEN

Where it was possible to determine the N content in the SNNP RTC site samples analysed, this falls within the recommended range for optimal plant growth.

ZINC

The Zn content of the sampled point at the SNNP RTC site was found to be within the recommended range for optimal plant growth.

CHLORIDE

Analysis results of the samples taken from the site indicated that the Chloride content within the site falls within the recommended levels for optimal plant growth.

ANTIMONY

The Sb content in the SNNP RTC site soil samples was low and thus not a hindrance to plant growth.

TOTAL ORGANIC CARBON

The analysis undertaken for the SNNP RTC site indicates that less than 8% ToC is present in the soils thus the soil health can be described is poor. As it has been established that the clay content elsewhere on the site is very likely to be higher than that of the sampled site, the ToC is also very likely to also be higher.

SOIL CAPABILITY ASSESSMENT

As stated in Section 8.5.4, the land capability of the Arcadia soil was established as Land Capability Group ‘Arable Soils’ and Land Capability Class IV. The distribution of land capability classes at the RTC site can be seen in **Figure 8-15**.

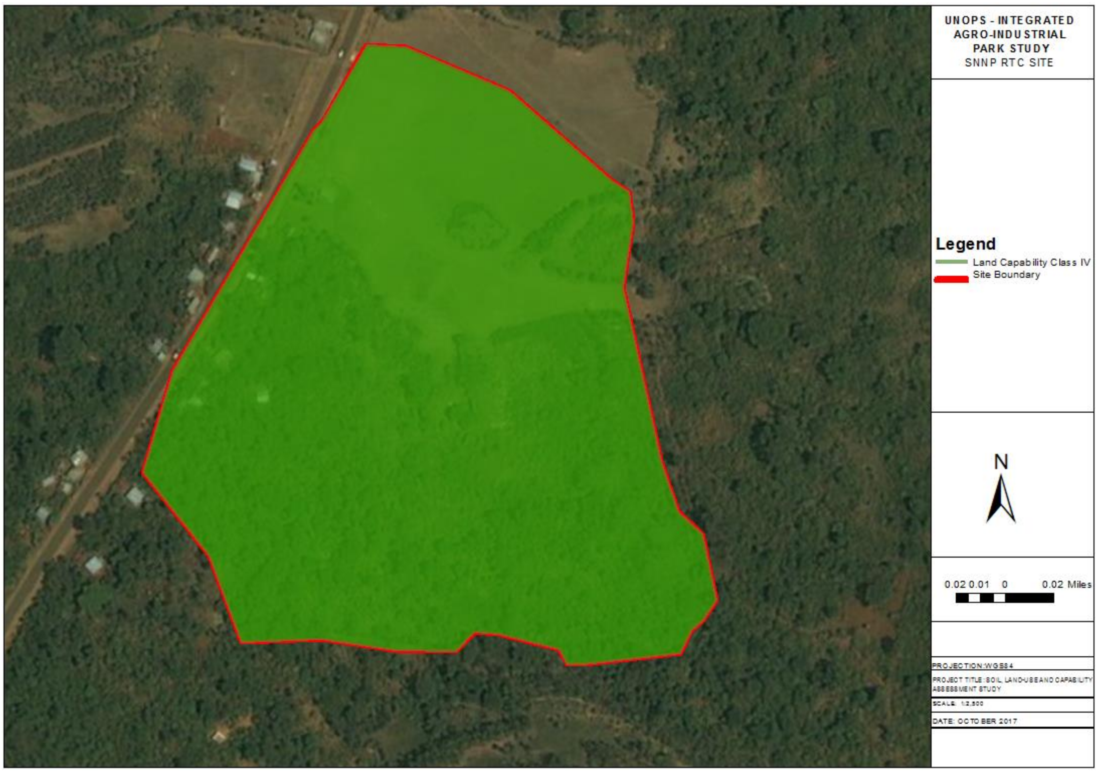

Figure 8-15: Figure showing distribution of land capability classes at the Dilla RTC.

8.6 SURFACE WATER (HYDROLOGY)

This section describes the receiving environment in terms of surface water within the Project site and surrounding area.

8.6.1 DESKTOP ASSESMENT

A detailed desktop assessment was undertaken for the SNNP IAIP and RTC sites. This included the sourcing and reviewing of relevant available surface water data. Data reviewed included site layout plans, relevant reporting, pertinent published data and interrogation of available databases.

DRAINAGE PATTERNS

The SNNP IAIP and RTC sites are situated within the Rift Valley Lakes Basin, which is one of the twelve major basins in Ethiopia (see **Figure 8-16**), with a total area of approximately 52,000 km^2.

The Rift Valley Lakes Basin is characterised by a chain of lakes varying in size as well as in hydrological and hydrogeological settings. It constitutes eight lakes, namely; Lake Ziway, Lake Langano, Lake Abiyata, Lake Shalla, Lake Hawassa, Lake Abaya, Lake Chamo, and Lake Beseka (Belete, Diekkruger, & Roehrig, 2015). **Figure 8-17** shows the location of the Project area in relation to the identified lakes, all of which are located southwest of the Ethiopian capital, Addis Ababa.

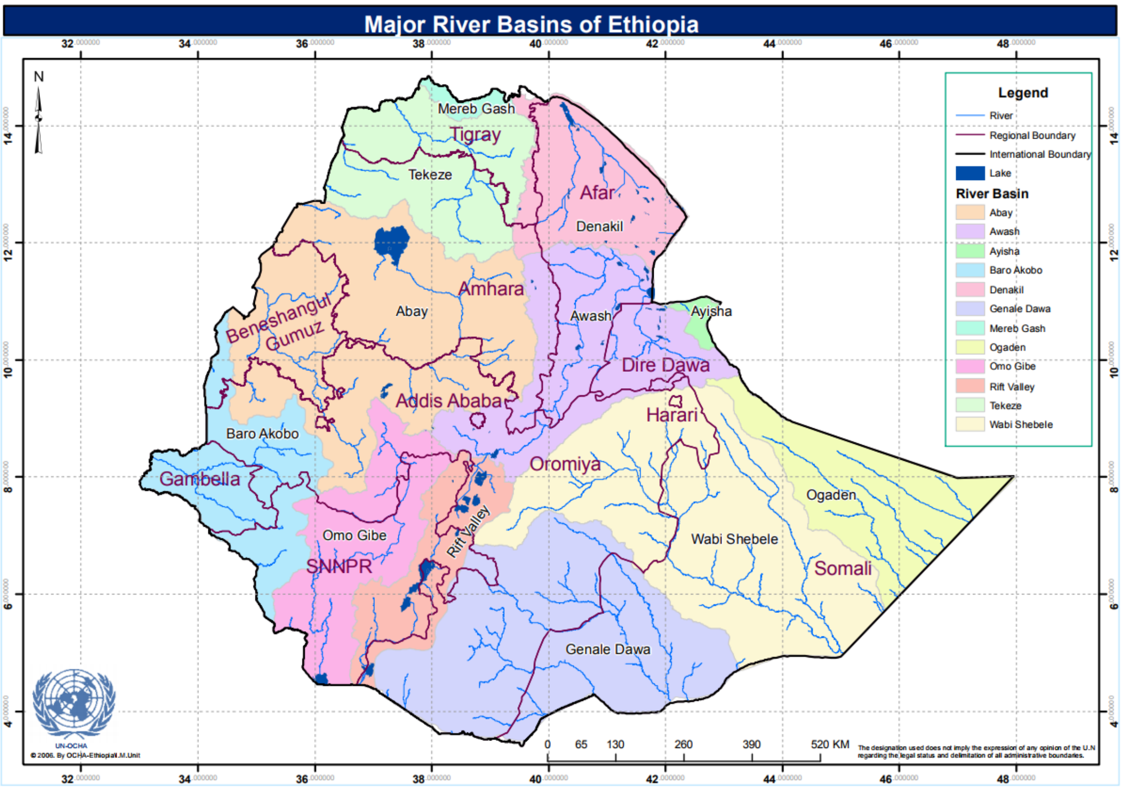

Figure 8-16: Major River Basins of Ethiopia (UN-OCHA, 2006)

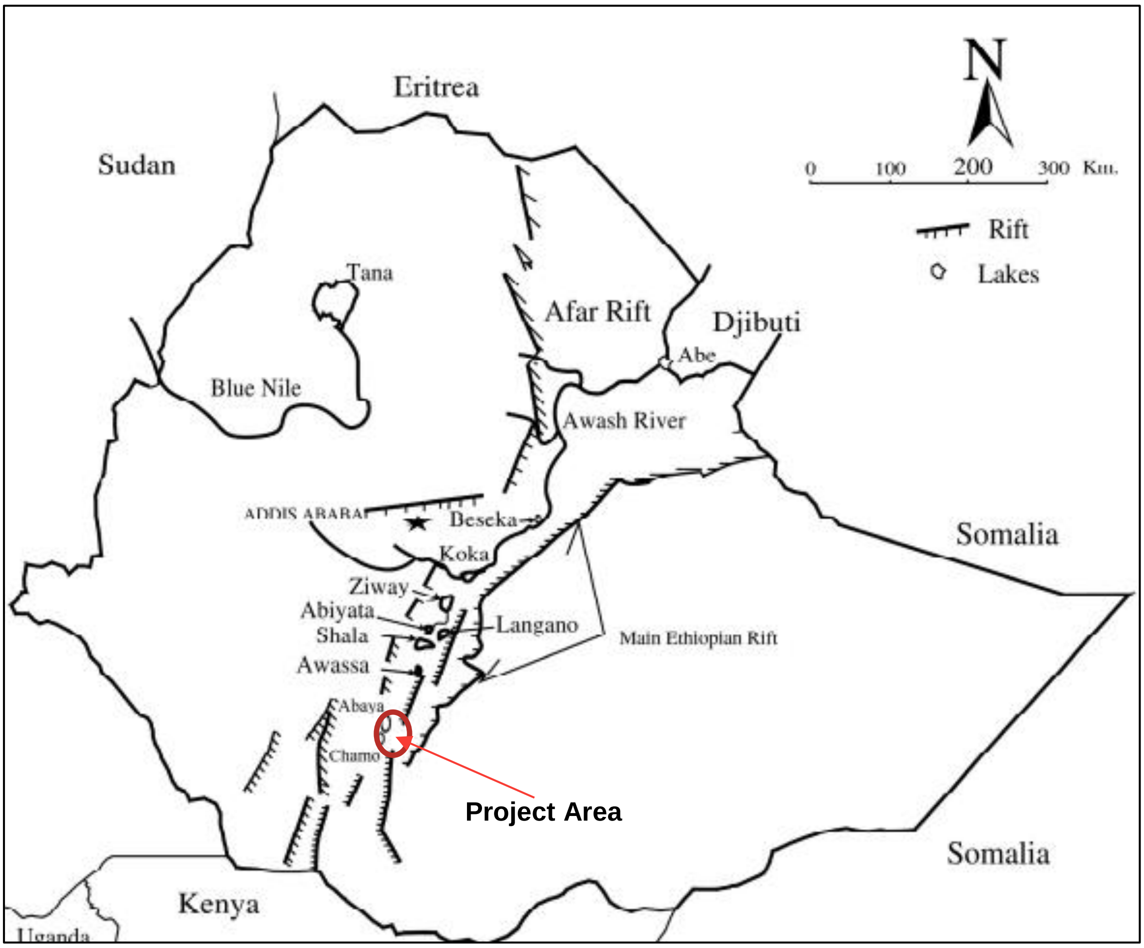

Figure 8-17: East African Rift Valley (Belete, Diekkruger, & Roehrig, 2015)

The Yirga Amem (IAIP) and Dilla (RTC) site falls within the Lake Abaya and Lake Chamo sub-basin. The specifications of the major lakes can be seen in **Table 8-10**. The major rivers within the sub-basin are the Bilate, Gidabo, Amessa, Guraccha, Kulfo, Gina, Sife and Chamo River.

Table 8-10: Specifications of the Major Lakes within the Rift Valley Basin

	Altitude (masl)	Surface Area (km^2)	Max Depth (m)	Average Depth (m)	Volume (km^3)
Ziway	1636	440	8.95	2.5	1.1
Langano	1582	230	47.9	17	5.3
Abijata	1578	205	14.2	7.6	1.6
Shalla	1558	409	266	87	36.7
Awassa	1697	129	22	11	1.3
Abaya	1285	1160	13	7	8.2
Chamo	1235	551	13	6	3.3

The Yirga Alem IAIP drainage system of the basin is strongly influenced by the morphology, which in turn is dependent on the geological phenomena. The area including the project site is drained by the Gidabo River flowing to Lake Abaya, the largest lake in the Ethiopian rift, with a 3302 km^2 drainage area which extends from the centre of the rift floor to the mountains of the rift boundary. The stream networks commonly show dendritic drainage patterns and the flow is east-west almost perpendicular to the strike of the escarpment in the upstream; however, in the rift floor the flow deflects to the southwest-northeast direction and displays a sub parallel pattern in the down course sections. There seems to be a strong relationship between the main stream course and geologic structures in the area.

The physiographic feature of the Dilla RTC site is similar to the Yirga Alem IAIP site, which is the result of faulting and volcanism associated with rifting processes. In the southern sector of the Main Ethiopian Rift, where the Gidabo River Basin is located, the collapse of the rift took place fairly regular in a single block. As a result the typical rift morphology is well developed and the three major physiographic regions, namely the rift floor, escarpment (where the project site located) and highland, are clearly visible. The major tectonic scarp connects the rift floor with the uplifted plateau; which rises to elevations of 3200 masl. Whereas the rift floor descends regularly into the Lake Abaya, where it lies at 1175 masl. An average elevation of the project site is 1535 masl which is on a transition between the rift floor and the eastern highland.

The whole catchment consists of the main Gidabo River and some tributaries which flow to the main River in a western direction. The catchment stream network shows a dendritic drainage pattern in the upstream areas and sub-parallel patterns in the downstream sections. In a dendritic system, there are many contributing streams which are joining together to the tributaries of the main river. The eastern part of the catchment is topographically higher while the south western part is lower near Lake Abaya. The nearby river on the northern side of the RTC project site, the ‘Chichu’ River (**Figure 8-18**), flows in an east-west direction until finally joining the Gidabo River. All surface water during the rainy season in the RTC site ultimately drains into the Chichu River.

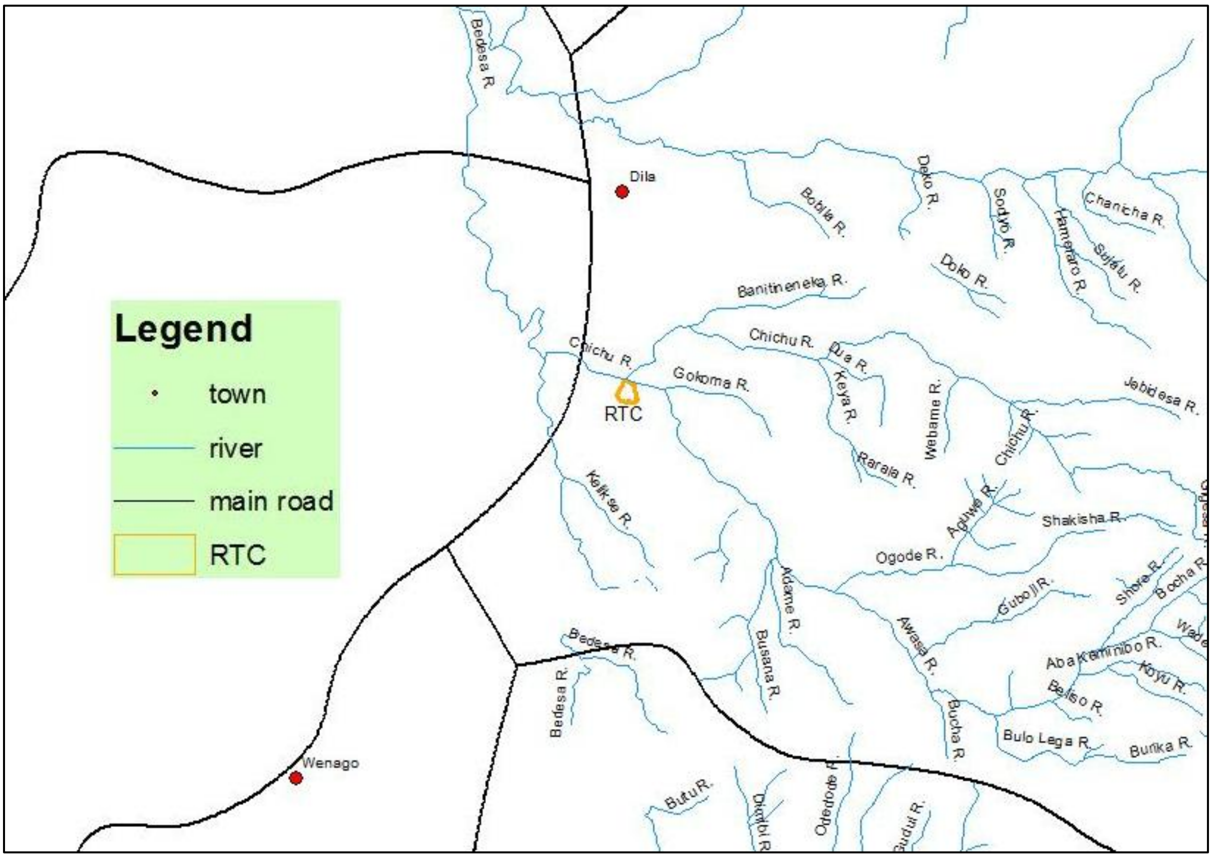

Figure 8-18: Dilla RTC and surrounding rivers (Source: Gebretensae, 2017)

RAINFALL

The Yirga Alem rainfall station was chosen to represent the SNNP IAIP site due to the proximity. The Mean Annual Precipitation (MAP) expected at the project site is approximately 1240mm with the wettest months occur between March and October and the driest months occur during November-February.

Rainfall data for the Dilla (RTC site) was obtained from the Dilla meteorological station and was chosen to represent the site due to the proximity. The MAP expected at the project site is approximately 1319 mm with the wettest months occur between March and October and the driest months occur during November- February.

MACE undertook an analysis of the 50-year dataset (1967-2016) for the storm water hydraulic analysis to determine the rainfall intensity. The dataset showed that the project site experienced a maximum rainfall event of 77.5 mm during June 1991. During the period of 2007-2016, the maximum rainfall event experienced was 48.8 mm per hours in May 2006, October 2007, October 2008 and November 2008. The rainfall intensity calculated and used for the storm water drain design was 75 mm/hr (MACE, 2017).

FLOW PATTERNS

Most rivers within the Rift Valley Basin are categorised as non-perennial. Even though some large rivers can be classified as perennial rivers, the amount of discharge in the dry season is quite limited. **Table 8-11** shows the low flows and high flows (m^3/s, mean figure of a month) of major rivers. Most of the flow rates are less than 2 m^3/s in the dry season, except for the Bilate and Kulfo River.

Table 8-11: Mean Monthly Flow of the Major Rivers (Dry and Wet Season) (Jica, 2008)

River Name	Measuring location	Low Flow (m^3/s)		High Flows (m^3/s)	
		Month	Mean	Month	Mean
Bilate	Bilaten	January	2.699	September	43.455
Kola	AletaWondo	February	0.555	August	5.696
Gidabo	Tore	March	1.110	May	7.932
Gelano	Getem	February	1.033	October	14.037
Hamassa	Wajifo	January	0.503	August	9.057
Hare	ArbaMinch	February	0.796	May	4.085
Kulfo	ArbaMinch	January	1.441	September	7.815
Kulfo	Output	February	3.433	May	7.695
Weyto	WeytoBridge	February	7.881	May	23.170

8.6.2 SITE ASSESSMENT

Site visits were conducted on during August and September 2017 at the Yirga Alem IAIP and Dilla RTC sites to ascertain the following:

- General site characteristics such as the site drainage, soils, vegetation, land uses and surface cover;
- General characteristics of the surrounding rivers such as the width of the channel, height of the banks and Manning's roughness coefficients; and
- Baseline water quality samples from the surrounding rivers.

YIRGA ALEM IAIP

No surface water resources are located within the IAIP site, however; as identified above the Gidabo River runs along the western boundary of the site in a south-westerly direction.

Areas located around the Yirga Alem IAIP are rich in both ground and surface water. The project site has a high potential of groundwater which is controlled by the rift fracture system in the eastern highlands. The eastern highlands and escarpment are a major area for groundwater recharge fed by the high levels of rainfall falling over an extensive area. There are numerous hot and cold springs and people come from long distances for healing treatments in the springs through bathing in and drinking the water.

The Aposto Spring system which is located about 3 km west of Yirga Alem town centre is one of the springs that discharge to the Darimo River, a tributary of the Gidabo River. The Gidabo River has the largest watershed in and around the study area, covering a total area of 216,817.74 ha and comprising of four sub-watersheds. Dama, Raro,Wamole and Woyima are sub-watersheds of Gidabo watershed each covering area of 8,170.56 ha, 5,580.72 ha, 16,938.72 ha and 4,678.11 ha, respectively (Adugna and Bogale, 2015).

The Gidabo River, flows parallel to the proposed IAIP site, approximately 700 m west of the boundary IAIP site (**Figure 8-19**).

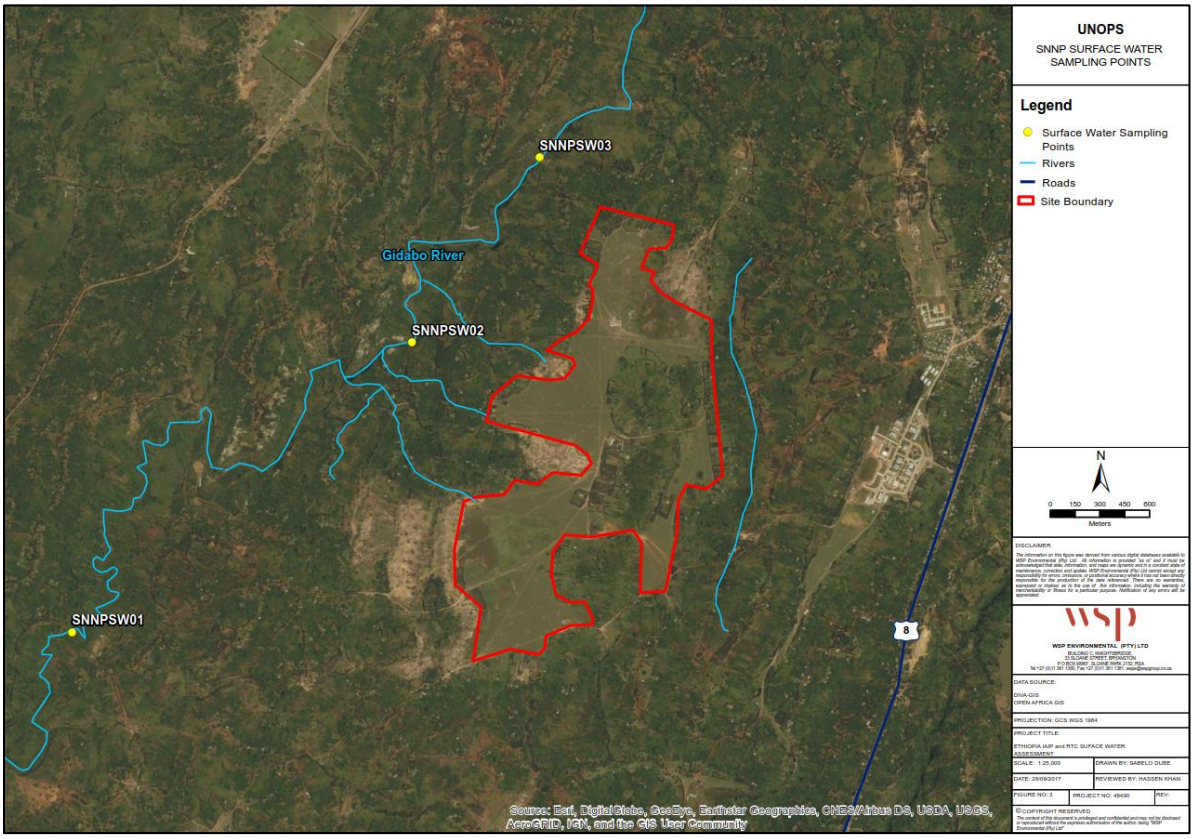

Figure 8-19: Image showing the location of the Gidabo River in relation to the IAIP (Source: Adapted from MACE report)

The average width of the Gidabo River is approximately 10-15 m and the height of the banks reach approximately 100 m in height in areas (see **Figure 8-20**). It was determined that the SNNP IAIP site is not at risk of being within the flood line. This can be attributed to the distance from the river as well as the altitude of the site above the river valley.

The presence of dispersal soils in the project area indicates that erosion will be higher in this area. This is evident where the valley areas show significant erosion gulley's (see **Figure 8-21**).

Figure 8-20: Photos showing the upstream and downstream view of the Gidabo River.

Figure 8-21: Erosion observed along the eastern boundary of the IAIP site (Source: ESIA Team site investigations)

WATER QUALITY ANALYSIS

Three baseline surface water quality samples were taken along the Gidabo River. The location of the sampling points are identified in **Table 8-12** and shown in **Figure 8-19** above.

Table 8-12: Surface water sampling points at the Yirga Alem IAIP

Surface Water Points	Easting	Northing	pH	Temp (ºC)	TDS (mg/l)	DO (mg/l)
SNNPSW01	424999.15 m E	743118.49 m N	7.49	19	45.5	7.69
SNNPSW02	427047.82 m E	745364.52 m N	7.52	19.1	45.5	7.93
SNNPSW03	428120.73 m E	746308.91 m N	7.3	19.7	46.15	7.6

The water quality results are shown in **Table 8-13** and these were compared to the following guidelines:

- Compulsory Ethiopian Standard-Drinking Water Specifications, 2013; and
- World Health organisation (WHO) Guidelines for Drinking Water Quality, 2008.

The water quality samples showed an exceedance in Turbidity which was evident at the time of sampling. This is indicative of the amount of erosion occurring within the catchment. All other parameters fell below the limits.

Table 8-13: Water Quality Results for Yirga Alem (SNNP)

Test	Units	LOD	Ethiopian Standard	WHO Guidelines	SNNPSW01	SNNPSW02	SNNPSW03
Dissolved Aluminium [#]	ug/l	<20	200	100	45	75	22
Dissolved Antimony [#]	ug/l	<2	-	20	<2	<2	<2

Test	Units	LOD	Ethiopian Standard	WHO Guidelines	SNNPSW01	SNNPSW02	SNNPSW03
Dissolved Arsenic #	ug/l	<2.5	10	10	<2.5	<2.5	<2.5
Dissolved Barium #	ug/l	<3	700	700	6	15	8
Dissolved Boron	ug/l	<12	300	500	<12	<12	<12
Dissolved Cadmium #	ug/l	<0.5	3	3	<0.5	<0.5	<0.5
Total Dissolved Chromium #	ug/l	<1.5	50	50	<1.5	<1.5	<1.5
Dissolved Copper #	ug/l	<7	2000	2000	<7	<7	<7
Total Dissolved Iron #	ug/l	<20	300	-	87	120	69
Dissolved Lead #	ug/l	<5	10	10	<5	<5	<5
Dissolved Manganese #	ug/l	<2	500	400	5	54	19
Dissolved Mercury #	ug/l	<1	-	6	<1	<1	<1
Dissolved Nickel #	ug/l	<2	-	70	<2	<2	<2
Dissolved Selenium #	ug/l	<3	-	10	<3	<3	<3
Dissolved Sodium #	mg/l	<0.1	200	40	6.9	6.4	6.6
Dissolved Uranium	ug/l	<5	-	15	<5	<5	<5
Dissolved Zinc #	ug/l	<3	5000	3	<3	<3	<3
Fluoride	mg/l	<0.3	1.5	1.5	<0.3	<0.3	<0.3
Sulphate as SO4 #	mg/l	<0.5	-	-	1	1	1.1
Chloride #	mg/l	<0.3	250	-	2.4	1.7	2.1
Nitrate as N #	mg/l	<0.05	50	50	1.4	1.33	0.74
Nitrite as N #	mg/l	<0.006	3	3	<0.006	<0.006	<0.006
Total Cyanide #	mg/l	<0.01	70	70	<0.01	<0.01	<0.01
Electrical Conductivity @25C #	uS/cm	<2	-	-	84	203	74
Free Ammonia as N	mg/l	<0.006	1.5	1.5	<0.006	<0.006	<0.006
Free/Residual Chlorine	mg/l	<0.02	0.5	5	<0.02	<0.02	<0.02
pH #	pH units	<0.01	6.5 - 8.5	6.5 - 8.5	7.41	8.11	7.42
Total Dissolved Solids #	mg/l	<35	1000	600	163	144	140
Turbidity	NTU	<0.1	-	5	47.5	43.7	37.6

DILLA RTC

The Dilla RTC site has no surface water features on the site. The Chichu River, which is a perennial river, runs in a westerly direction approximately 200 m north of the RTC site boundary (Figure 8-22 . The section of river in closest proximity to the RTC site is used by locals to wash their vehicles, including trucks (see **Figure 8-23**).

As a result of the topography of the site, surface water runoff during rain events generally drains across the site in a north-westerly direction, toward the Chichu River. Due to the limited surface runoff, as well as other activities taking place within the river, no surface water monitoring was undertaken at the site.

Figure 8-22: Image showing the location of the Chichu River in relation to the Dilla RTC site.

Figure 8-23: Photo showing locals using the Chichu River for cleaning of vehicles (Source: ESIA Team site investigations)

8.7 GROUNDWATER (HYDROGEOLOGY)

This section describes the receiving environment in terms of groundwater within the Project site and surrounding area.

8.7.1 DESKTOP ASSESSMENT

A detailed desktop assessment was undertaken for the SNNP IAIP and RTC sites prior to site work commencing. All available data, including topography data, climate data, hydrogeological classification maps, drilling and pump testing reports and design plans, was reviewed. This data allowed for the establishment of general hydrogeological conditions on site, and was used as the basis for the planning of the site investigation.

Baseline information was gathered from available regional geological and hydrogeological maps and reports, as well as drilling and pump testing reports for water supply boreholes drilled on the SNNP IAIP site. A number of water supply boreholes are present at the SNNP RTC site, although no information was found on these boreholes. However, according to the geological and hydrogeological maps consulted, the geological and hydrogeological conditions at the IAIP site is similar to that encountered at the RTC site. Thus the general hydrogeological baseline conditions are described as a whole for both the IAIP and RTC sites in the following sections.

8.7.2 SITE ASSESSMENT AND HYDROCENSUS

Site visits were conducted during August 2017 at the SNNP IAIP and RTC sites. During the sites visit, a detailed hydrocensus was carried out across the areas in order to identify all groundwater users and/or groundwater abstraction points. A total of two points were identified at the IAIP site and three points at the RTC site. The following steps were taken and data gathered at each identified point:

- Location of the point was recorded using a hand held GPS;
- The depth to groundwater was measured and recorded using an electronic dip meter;
- Information was gathered from the water source owner or the water users regarding water use, abstraction volumes, water reliability and availability between wet season and dry season and water quality; and
- Water samples were collected in laboratory approved containers in accordance with internationally accepted best practice guidelines and were submitted to a suitably accredited laboratory for chemical analysis.

8.7.3 GEOLOGY

The SNNP IAIP and RTC sites are located within the East African Rift, and as a result the geology is dominated by Rift related volcanics. Regionally, the geology of the area can be categorised into three distinct groups:

- Pre-Rift volcanic rocks;
- Rift volcanic rocks; and
- Post Rift Sediments.

The dominant lithologies, listed from oldest to youngest, are as follows:

- Basalt, rhyolite and trachyte;
- Ignimbrites, tuffs and pyroclastics; and
- Volcano clastic sediments and tuffs

The local geology was confirmed through the drilling of water supply boreholes at the SNNP IAIP site, which encountered tuff and ignimbrite overlying basalt and tachyite.

Structurally, the volcanic sequences are densely dissected by extensional fault systems as a result of the rifting process. These fault systems will play an important hydrogeological role in terms of targets for groundwater supply boreholes.

8.7.4 HYDROGEOLOGY

AQUIFER TYPES AND CHARACTERISTICS

The hydrogeology of the area is largely governed by the geometry of the rift, the variability and lateral discontinuity of the volcanic rocks and the disruption of lithologies by faults, resulting in vertical structuring and spatial heterogeneity across the region. The aquifers are largely the product of volcanic eruptions which occurred in the area at different times and different locations throughout the regions geological history. Water levels in the region are relatively deep, typically ranging from 45 to 90 meters below the surface.

The lithology and structure of the area has led to two main aquifer types within the IAIP and RTC project areas, these are:

WEATHERED AQUIFER

A weathered zone aquifer system exists in the weathered volcanoclastic sediments. Groundwater in the aquifers generally occurs under unconfined conditions. The weathered zone has a relatively low groundwater potential, and was not greatly targeted for water supply at the IAIP or RTC sites.

FRACTURED AQUIFER

A deeper, fractured rock aquifer occurs in the lithologies underlying the weathered zone. Groundwater flow occurs in discrete fractures and primary porosity, which form preferential flow paths within the geological unit under confined conditions. The fractured rock aquifer represents the major aquifer in the region, with deep supply wells being drilled into it in and around the IAIP and RTC sites. Yields from the fractured rock aquifer are good, presenting a feasible source of water supply, with sustainable abstraction yields of up to 10 litres per second (l/s) to be expected.

HYDRAULIC PARAMATERS

The hydraulic parameters of an aquifer describe the ease with which groundwater (and thus potential contaminants contained within the groundwater) moves through the subsurface and is used to predict the rate of groundwater movement. The higher the hydraulic conductivity and/or transmissivity, the faster groundwater will move through an aquifer. The hydraulic parameters are obtained by conducting aquifer tests on borehole drilled into the relevant aquifer units.

Hydraulic parameters of the main aquifer unit (fractured aquifer) were obtained from the pump testing results of one of the deep water supply boreholes drilled for the SNNP IAIP site. Due to the similar geological and hydrogeological conditions across the region and the lack of additional pump testing information, it has been assumed that the hydraulic parameters are similar for the rest of the area. Aquifer parameters were obtained by conducting step tests, constant discharge tests and recovery tests on the borehole. The results of this testing has been summarised in **Table 8-14**.

Table 8-14: Summary of Calculated Aquifer Parameters

Well Designation	SWL (m)	Draw-down (m)	Yield (l/s)	Specific Capacity (l/s/m)
Deep Well – BH12	85	34	9.16	15.35

HYDROCENSUS

During the August 2017 site investigation, a detailed hydrocensus was carried out across the IAIP and RTC Site areas. The hydrocensus resulted in the following findings:

YIRGA ALEM IAIP SITE

The hydrocensus for the IAIP site resulted in the following findings:

- Local communities in and around the IAIP site rely heavily on groundwater as their source of water, with groundwater forming the bulk of their water supply.

- Four boreholes fitted with hand pumps were identified throughout the area. However, only one of these were operational due to mechanical failure of the hand pumps in the remaining three.
- Two operational water supply boreholes were identified around the site (SNNP04 and SNNP05), one equipped with a hand pump, located approximately 250m to the east of the northern portion of the IAIP site, and one equipped with a solar pump approximately 500m west of the southern portion of the IAIP site. The solar pump discharges water to a central collection point approximately 120m south of the borehole.
- A perennial spring was identified approximately 650m to the west of the SNNP project site, adjacent to the Gidabo River. The recharge area for this spring could potentially be within the SNNP IAIP project site.

A summary of all of the groundwater points identified is provided in **Table 8-15** and their locations are shown in **Figure 8-24**.

Table 8-15: Yirga Alem IAIP site groundwater point summary

Groundwater Point	Easting	Northing	Type	Status	Static water level (mbgl)	Comments
SNNPGW01	427845	743598	Project water supply borehole	Not in use	Unable to measure	Deep borehole drilled as part of the water supply programme for the IAIP site
SNNPGW02	427680	742860	Hand pump	Not in use	Unable to measure	Shallow borehole fitted with hand pump. Not in use due to mechanical failure of the pump
SNNPGW03	428914	744277	Hand pump	Not in use	Unable to measure	Shallow borehole fitted with hand pump. Not in use due to mechanical failure of the pump
SNNPGW04	426728	743415	Solar pump	In use	48.06	Community water supply borehole fitted with solar pump. Water is pumped to a central collection point approximately 120m south west of the borehole
SNNPGW05	428857	745454	Hand pump	In use	Unable to measure	Shallow borehole fitted with hand pump. Used by local community for domestic water supply
SNNPGW06	429089	746093	Hand pump	Not in use	Unable to measure	Shallow borehole fitted with hand pump. Not in use due to mechanical failure of the pump
SNNPGW07	428626	745077	Project water supply borehole	Not in use (collapsed)	39.58	Deep borehole drilled as part of the water supply programme for the IAIP site. Borehole abandoned due to collapse during drilling
SNNPGW08	427763	744647	Project water supply borehole	Not in use	Unable to measure	Deep borehole drilled as part of the water supply programme for the IAIP site
SNNPGW09	428558	743396	Hand pump	Not in use	Unable to measure	Shallow borehole fitted with hand pump. Not in

Groundwater Point	Easting	Northing	Type	Status	Static water level (mbgl)	Comments
						use due to mechanical failure of the pump
SNNPGW10	427032	744895	Spring	In use	N/A	Spring located approximately 650m west of the IAIP project site. Used by local community for domestic water supply

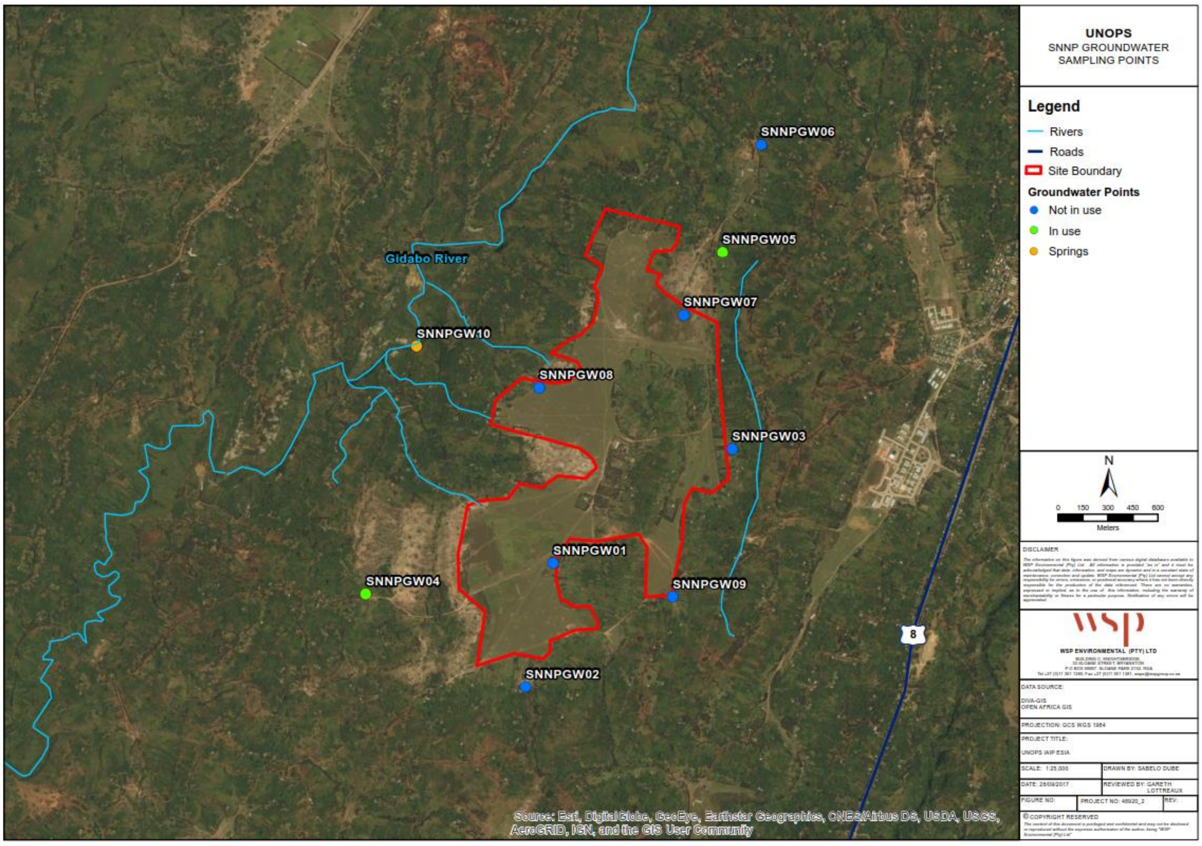

Figure 8-24: SNNP IAIP Groundwater Points

DILLA RTC SITE

The hydrocensus for the RTC site resulted in the following findings:

- The RTC site is located in close proximity to the town of Dilla. There are a number of deep water supply boreholes located around Dilla.
- One of these boreholes, Deep Well 1, is located within the SNNP RTC site boundary. The second, Deep Well 2, is located just to the North of the RTC boundary, on the western side of the road. No information was found on these boreholes. Deep Well 1 appeared to be operational at the time of the August 2017 site visit. Deep Well 2 was not operational.
- A spring (Spring 1) was identified approximately 900m to the west of the SNNP RTC site boundary. The spring is used as a source of domestic water supply by local community members.

A summary of all of the groundwater points identified is provided in **Table 8-16**, and their locations are shown in **Figure 8-25**.

Table 8-16: Dilla RTC site groundwater point summary

Groundwater Point	Easting	Northing	Type	Status	Static water level (mbgl)	Comments
Deep Well 1	423334	705021	Municipal supply borehole	In use	Unable to measure	Deep water supply borehole located in the south west corner of the RTC site. Operational at time of August 2017 site visit
Deep Well 2	423396	705319	Municipal supply borehole	In use	Unable to measure	Deep water supply borehole located adjacent to the north east corner of the RTC site. Not operational at the time of the August 2017 site visit
Spring 1	422434	705314	Spring	In use	N/A	Spring located approximately 900 meters west of the RTC site. Used by local community for domestic water supply

Figure 8-25: SNNP RTC Groundwater Points

GROUNDWATER POTENTIAL CONTAMINANTS

Sources of contamination to groundwater at the Yirga Alem IAIP site are relatively limited, due to the limited development in and around the area. Main potential contaminants of concern would be micro biological contamination from faecal waste originating from unlined pit latrines and livestock waste.

The Dilla RTC site is located in relatively close proximity to the town of Dilla. As with the IAIP site, the main potential contaminants of concern are biological contaminants. However, the risk of contamination is slightly higher due to the increased population density in the area.

GROUNDWATER QUALITY

A total of three groundwater samples were collected from the Yirga Alem IAIP site, one from the borehole equipped with a solar pump (SNNPGW04), one from a hand pump (SNNPGW05) and one from the spring to the west of the IAIP site (SNNPGW10). The samples were submitted to an internationally accredited laboratory for chemical analysis during the August 2017 site visit. The results of the analysis are presented in **Table 8-17**. The complete laboratory report is attached in **Appendix B** of the specialist report which is attached as **Appendix C-3**.

Table 8-17: Water Quality Results for SNNP IAIP Site

Test	Units	Ethiopian Standard	WHO Guidelines	SNNPGW04	SNNPGW05	SNNPGW10
Aluminium	µg/l	200	100	<20	<20	<20
Antimony	µg/l	-	20	2	<2	<2
Arsenic	µg/l	10	10	<2.5	<2.5	<2.5
Barium	µg/l	700	700	13	<3	<3
Boron	µg/l	300	500	12	<12	<12
Cadmium	µg/l	3	3	<0.5	<0.5	<0.5
Total Chromium	µg/l	50	50	<1.5	<1.5	<1.5
Copper	µg/l	2000	2000	<7	<7	<7
Total Iron	µg/l	300	-	<20	22	<20
Lead	µg/l	10	10	<5	<5	<5
Manganese	µg/l	500	400	4	<2	<2
Mercury	µg/l	-	6	<1	<1	<1
Nickel	µg/l	-	70	<2	<2	<2
Selenium	µg/l	-	10	<3	<3	<3
Sodium	mg/l	200	40	24.1	35.8	**49.4**
Uranium	µg/l		15	<5	<5	<5
Zinc	µg/l	5000	3000	1687	9	<3
Fluoride	mg/l	1.5	1.5	0.5	1.2	0.9
Sulphate as SO_4	mg/l			2.6	0.8	<0.5
Chloride	mg/l	250	-	7.1	1.6	1.1
Nitrate as N	mg/l	50	50	3.36	0.40	0.17
Nitrite as N	mg/l	3	3	<0.006	<0.006	<0.006
Total Cyanide	mg/l	70	70	<0.01	<0.01	<0.01
Electrical Conductivity	µS/cm	-		233	320	297
Free Ammonia as N	mg/l	1.5	1.5	<0.006	<0.006	<0.006

Test	Units	Ethiopian Standard	WHO Guidelines	SNNPGW04	SNNPGW05	SNNPGW10
Free/Residual Chlorine	mg/l	0.5	5	<0.02	<0.02	<0.02
pH	pH units	6.5 - 8.5	6.5 - 8.5	7.23	7.37	7.27
Total Dissolved Solids	mg/l	1000	600	261	299	300
Turbidity	NTU	-	5	0.4	0.2	0.3

The results of the groundwater quality analysis indicate that the groundwater quality in the area is good, with only sodium values being elevated slightly above the WHO recommended guidelines in the spring (SNNP10) sample. However, at the recorded values, the effects are expected to be purely aesthetic and do not pose a threat to human health.

8.8 WETLANDS

This section describes the receiving environment in terms of wetlands within the Project site and surrounding area.

8.8.1 DESKTOP ASSESSMENT

An in-depth desktop assessment, utilising aerial imagery (2012 - 2016) and available datasets, was conducted to determine potential wetland/freshwater habitats. This desktop analysis was vital due to the extent of the area under assessment.

Ethiopia is reported to have more than 58 different types of wetlands which provide significant socio-economic and environmental values. Despite their small area coverage, wetlands in Ethiopia are among the most productive ecosystems, and have significant economic, social, and environmental benefits. The importance of Ethiopian wetlands goes beyond their status as habitat of many endangered flora and fauna species but they are a vital element of national and global ecosystems and economies (Mengesha, 2017). Despite all this and other indispensable values, these wetlands are under severe pressure and degradation (Seid, 2017).

The most common threats to wetlands are the result of a combination of social, economic and climatic factors, which have increased pressure on the natural resources in Ethiopian wetlands. Wetlands in Ethiopia are being transformed and altered at a significant rate into what many people consider better alternative uses.

The main activities resulting in the transformation of wetland habitat in Ethiopia include the unregulated conversion for agricultural production (including draining and diversion of water), overgrazing, clearance and overharvesting of vegetation and appearance of alien invasive plant species (Desta and Mengistou, 2009; Kassa and Teshome, 2015; Mengesha, 2017; Seid, 2017). Another constraint to the sustainable use of African wetlands is lack of knowledge by planners and natural resource managers of the benefits that specific wetland habitats provide and techniques by which these habitats be utilised in a sustainable manner (Mengesha, 2017).

The impacted wetlands provide various socioeconomic and ecological benefits to society, which are or have the ability to significantly improve the livelihood of the communities surrounding the wetland systems. As the level of wetland degradation increases their benefit is also reduced (Kassa and Teshome, 2015).

Ethiopia has not yet ratified the Ramsar Convention on wetlands and, therefore, none of the identified 25 potential Ramsar wetlands in the country is designated in the list of wetlands of international importance (Mereta, 2013; Harper *et al.,* 2016). Regardless of their vital role in food security and rural livelihood, the extent, diversity, distribution and conservation status of wetlands in Ethiopia is not well documented. Furthermore, there are no clear policies and strategies that protect wetlands in the country. Although wetland related issues are included in Ethiopian water resources, agricultural and

environmental policies, the implementation of wetland management and conservation in the context of the above policies is compounded by a 'more pressing wetland task force, extension package and food security policies that may seek to convert wetlands for agricultural purposes' (Mereta 2013).

In Ethiopia, there is a lack of efficient and sufficient coordination and policy support, relating to wetland management. Due to the absence of workable institutional arrangement and wetland management policy, sustainable wetland management and capacity building are not encouraged. The result is a shortage of skilled manpower which is capable of disseminating the concept of wise use of wetlands (Birhan *et al*., 2015; Seid, 2017).

8.8.2 SITE ASSESSMENT

An infield assessment was conducted during August 2017 and the confirmed systems were delineated and assessed, along with additional systems identified during the infield assessment.

The methods used for the wetland delineation broadly followed the approach as outlined below:

- Desktop identification of watercourses within the boundary of the proposed sites;
- Infield delineation and classification of watercourses within the proposed sites;
- Functional assessments of the potentially impacted watercourses (i.e. PES, EIS).

For an in-depth description of each individual method refer to the specialist report attached as **Appendix C-4**. Available datasets were utilised, to supplement the information gathered on site.

8.8.3 YIRGA ALEM IAIP

WETLAND DELINEATION

There are numerous definitions for wetlands, with no one definition being agreed upon on an international scale. This is attributed to different ideas on the boundary of between the aquatic system and the surround terrestrial environment and the natural variations in climatic conditions, hydrology, soils and vegetation communities.

According to the Ethiopian Water Resources Management Policy the definition of a wetland is "areas of marsh, fen, peatland or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water the depth of which at low tide does not exceed six meters". This definition is also utilised within numerous papers published in internationally accepted Journals and papers within the International Union for Conservation of Nature and Natural Resources (IUCN) publication "Wetlands of Ethiopia. Proceedings of a seminar on the resources and status of Ethiopia's wetlands" (Abebe & Gehab, 2003).

Wetland delineation includes the confirmation of the occurrence of wetlands and a determination of the outermost edge of the wetland. Therefore the definition above was utilised to identify wetland areas within and around the SNNP IAIP and RTC sites. After these systems had been identified, the following wetland indicators were used to delineate the wetlands:

- Terrain Unit Indicator
- Soil Form and Wetness Indicator
- Vegetation Indicator

A total of seven (7) wetland habitats were identified on the IAIP site, which comprise of artificial and natural depressions (**Figure 8-26**).

WETLAND CLASSIFICATION

In order to identify the wetland types, a characterisation of hydrogeomorphic (HGM) types was conducted. These have been defined based on the geomorphic setting of the wetland in the landscape (e.g. hillslope or valley bottom, whether drainage is open or closed), water source (surface water dominated or sub-surface water dominated), how water flows through the wetland (diffusely or

channelled) and how water exits the wetland. Once these systems have been defined into individual HGM units they can be classified.

The HGM Approach considers structural components of the wetland and surrounding landscape such as plants, animals, hydrology, and soils; biological, chemical, and physical processes; and the interaction of these components and processes. Surrounding land use is addressed because it impacts structural components and processes in the wetland.

The identified systems were classified into respective HGM units, as identified **Table 8-18**. The extent of each of the HGM units is illustrated in **Figure 8-26**. While **Figure 8-27** provides photographic examples of wetland units identified on the IAIP site.

Table 8-18: Identification of wetland habitat located within the proposed development footprint.

Project Code	Ramsar Classification	HGM Unit	Ethiopian Biome	Nature	Co-ordinates	
					UTM E (m)	UTM N (m)
W1	Seasonal/intermittent freshwater marshes/pools on inorganic soils (Ts)	Depression	Somali - Masai	Natural	427806.02	743527.15
W2		Depression		Natural	427837.62	743744.52
W3		Depression		Natural	428449.91	743377.97
W4		Depression		Natural	428564.17	745504.72
W5		Depression		Natural	428761.25	744100.75
W6	Pond (2)	Depression		Artificial	428734.21	744318.82
W7	Pond (2)	Depression		Artificial	427657.20	744506.04
R1	Seasonal/intermittent/ irregular rivers/ streams/ creeks (N)	Riverine		Natural	428798.61	744963.32

The depression wetland units (W1-W7) identified onsite are characterised by their endorheic character and are circular to oval shape. They occur in relatively small enclosed basins and are typically ephemeral in nature, typically being filled with shallow water levels during the rainy season. There are also systems that appear to be perennial in nature however this is only due to anthropogenic excavations to create yearlong water sources.

The riverine system (R1) is a minor ephemeral channel, located within a valley floor that carries intermittent unidirectional longitudinal flows. The water inputs are mainly from channel entering the system and also from overland flow from adjacent valley-side slopes. There was no flowing water during the site visit which was conducted during the rainy season. The system and its micro-catchment are denuded of vegetation and significantly eroded downstream, outside of the site boundary. Water is usually lost from the system via diffuse surface flow and interflow into adjacent channel, infiltration and evaporation.

The dominant water inputs and outputs are dictated primarily by the outflow and inflow drainage characteristics. The hydrodynamics of these depressions are, however, typically dominated by vertical water level fluctuations. The depressions do not have any outward (downstream) drainage or any inflow channels and therefore are not connected to a river network and are considered ‘isolated depressions’.

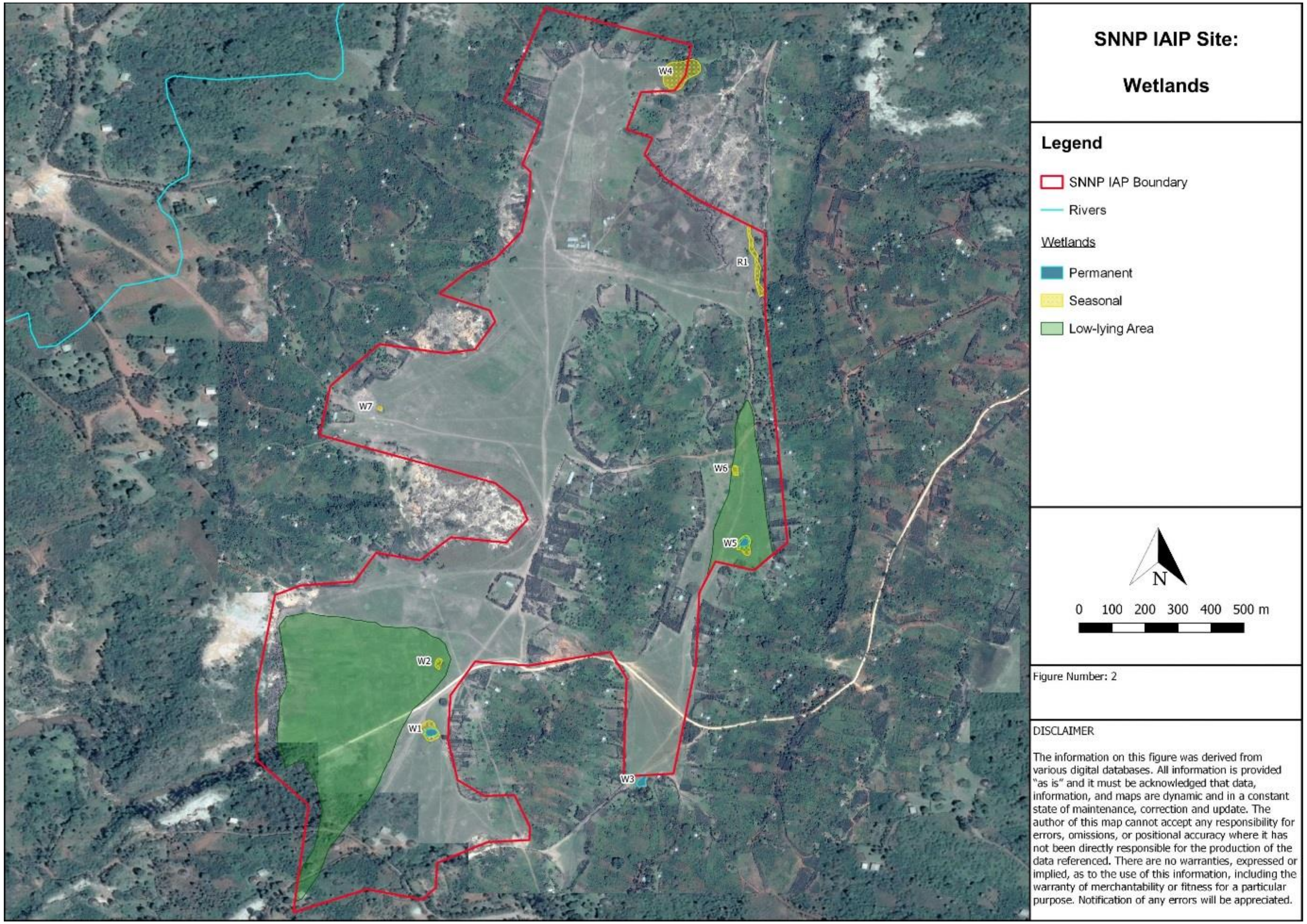

Figure 8-26: Wetland Units within the IAIP site

Figure 8-27: Photos of some of the wetland units identified on the IAIP site (Source: ESIA Team site investigations)

PRESENT ECOLOGICAL STATE

The W1 - 5 depression wetlands are considered to be natural in origin with the units ranging from minimal to serious modifications having occurred. W2 and W4 are in a near-natural state with W1 and W5 having experienced significant excavations. These systems are still however functioning and providing goods and services within the natural environment. W6-7 are artificial systems created by excavating to below the water table creating a ‘pond’ system.

All the depressions besides W2 is devoid of vegetation with wetland obligate species being present only around the fringes of the system, attributed to the anthropogenic excavations creating permanent waterbodies. The various micro-catchments have been transformed from natural vegetation to agricultural land for crop production and grazing, dominated by the G*raminoid* species *Cynodon dactylon*.

The catchment impacts include landscape transformation from the natural state due to informal housing, unpaved road infrastructure, livestock/human tracks, grazing and subsistence farming practices. These impacts have resulted in modified surface runoff regimes as there is a reduction in surface roughness and modified soil permeability. Alien invasive plant species such *as Eucalyptus grandis* are also present within the catchment in disturbed areas. Soil erosion is largely restricted to outside the site boundary however active gully formation has resulted in instability of the soil profile along the western boundary of the site.

The ephemeral channel (R1) is exposed to significant erosive forces from concentrated flow of stormwater. The catchment along the middle and lower reaches of the system is devoid of vegetation and eroded down to bedrock in many places. Additionally erosion (incision of the bed of the channel) and sedimentation has occurred within the R1 system itself.

A major indirect factor resulting in the degradation of the wetlands’ current state is poverty. The wetland resources are utilised in an attempt to make a livelihood, however as these are limited resources they have been over exploited (Dabassa, 2010). The vegetation resources have been denuded and the majority of the bird and other wild fauna species have left these wetlands (and the surround catchments) due to loss or transformation of their natural habitats, i.e. trees have been removed and grasses been overgrazed (EPA, 2004).

Grazing is a direct threat to these wetlands in addition to the above factors. Due to historic grazing followed by cultivation; wetlands and their catchments easily became degraded and lost their natural characteristics (consequently their resources as well) as with the IAIP site. The livestock lead to soil

compaction and vegetation loss as they trample the soil and compact it, resulting in the transformation of the natural vegetation (Coates et al. 2010). They have eroded drainage channels leading to gullies and increase water outflow. These effects have resulted in the degradation of the wetlands and their catchments by reducing the water table and by changing the original vegetation (Mengesha, 2017).

FUNCTIONAL ASSESSMENT

The typical functionality of depression wetlands tends to contribute less towards flood attenuation, but would supply this benefit to a certain extent and would be limited by the position of the system in the landscape. They naturally capture runoff, during stormflow conditions, due to the inward draining characteristic, and therefore to some extent aid in reducing the volume of surface water that would otherwise enter the natural systems in the area unattenuated. However this inward draining also means these systems don't typically supply a streamflow regulation function. The potential for removal of nutrients and toxicants would generally be expected to some degree.

Nitrogen cycling is likely to be important with some losses due to de-nitrification, and volatilization in the case of high pHs. Water quality in pans is influenced by the pedology, geology, and local climate. These factors, in turn, also influence the response of these systems to nutrient inputs. In pans that dry out completely at some stage or another (non-perennial pans), some of the accumulated salts and nutrients (such as organic nitrogen, and various phosphate and sulphate salts) can be transported out of the system by wind and be deposited on the surrounding slopes. Those remaining may dissolve again when waters enter the system again as the pan fills after rainfall events (Kotze et al. 2009).

Wetlands are important in biogeochemical cycling, which involves the biological, physical, and chemical transformations of various nutrients within the biota, soils, water, and air (Yang *et al*., 2008). Wetlands are very important in this regard, particularly relating to nitrogen, phosphorous and carbon. Nitrogen transformations in wetlands are complex due to the multiple oxidation states of nitrogen molecule (Davidson and Mattias, 2000; Bohlen and Gathumbi, 2007; Vymazal, 2007). The major transformations include mineralization of organic nitrogen, ammonia volatilization, nitrification, nitrogen fixation, plant uptake, denitrification, anaerobic ammonia oxidation, fragmentation, sorption, desorption, burial and leaching (Davidsson and Mattias, 2000; Vymazal, 2007). Mineralization of organic nitrogen in sediments provides the major source of nitrogen to wetland plants and is responsible for the high rates of productivity of many wetlands ecosystems (Bohlen and Gathumbi, 2007).

Phosphorous has no significant atmospheric flux and has a much longer temporal biogeochemical cycle than nitrogen (White *et al*., 2000). Slow water flow through a wetland is essential for settling of particulate phosphorous (Van der Valk *et al*., 1978). Wetlands are one of the most effective ecosystems for storing soil carbon (Schlensinger, 1997; Mereta 2013)

The depression wetlands do not provide streamflow regulation, erosion control, sediment trapping or phosphate removal to any significant extent. There is a slight flood attenuation benefit due to their storage ability however this is limited (only really effective early in the wet season) due the systems being at capacity fairly early on the wet season. There is also minor nitrates and toxicant removal attributed to the systems.

There is no, to minimal, provision in terms of cultivated foods, tourism/recreation, education/research and/or socio-cultural aspects derived directly from these systems. This is mostly due to the lack of vegetation cover, lack of endangered species and available harvestable resources. Due to the low organic content and subsequent lack of peat all the systems are not significant in terms of carbon storage. The provision of water for human use is the only benefit that is considered a significant service provided by wetland W1, W3 and W5.

However wetland size plays a major role in the contributing to the provision of particular benefits. The size of wetland in relation to benefits such as flood attenuation, sediment trapping and phosphate assimilation is always very important; with nitrate and toxicant removal, erosion control, cultivated foods and carbon storage usually being determined by wetland size. The ability for the systems to provide goods and services such as water supply, streamflow regulation and biodiversity maintenance is less dependent on the size of the systems. Therefore as the systems are small in extent and isolated, the ability to provide the abovementioned goods and services is further hindered.

8.8.4 DILLA RTC

The desktop screening and infield assessments of the Dilla RTC determined that there were no wetland habitats within the site boundaries or in close proximity to the site, where there was a potential for wetland habitats to been indirectly impacted. Site investigations confirmed that the RTC site showed no signs of wetland habitat within its boundary.

8.9 AIR QUALITY

This section describes the receiving environment in terms of Air Quality within the Project site and surrounding area.

8.9.1 YIRGA ALEM IAIP

Potential sources of emission surrounding the proposed site include:

- Vehicle entrainment on unpaved roads;
- Vehicle tailpipe emissions;
- Domestic fuel burning;
- Agricultural activities.

Table 8-19 presents all the proposed production units within the IAIP as well as potential significant sources of air quality within each unit. It is anticipated that most units will not generate significant emissions with trucks the main source of particulate and gaseous emissions. The boiler will also generate emissions during start-up, normal and abnormal operating conditions. Detailed information on each source (such as source type, fuel consumption and operational hours) is required to assess the potential impact of emissions from sources on the surrounding area.

Table 8-19: List of various IAIP units and associated air quality sources

Unit	Potential Air Quality Sources	Pollutants
Sewage treatment plants	Composting	Odour, TSP, PM_{10}, $PM_{2,5}$, SO_2, NO_2, CO, VOCs
	Septic wastewater or sludge	
	Solids processing	
	Trucks	
Solid waste management plant	Trucks	TSP, PM_{10}, $PM_{2,5}$, SO_2, NO_2, CO, VOCs
	Conveyors	
Boiler, chiller & compressor	Boiler	PM_{10}, $PM_{2,5}$, SO_2, NO_2, CO, VOCs
Milk & Dairy Plant	Boiler (if applicable)	PM_{10}, $PM_{2,5}$, SO_2, NO_2, CO, VOCs
	Filling/empting milk tankers and storage silos	Odour
	Spray drying systems, bagging of product (milk powder residues)	TSP, PM_{10}, $PM_{2,5}$
	Trucks	TSP, PM_{10}, $PM_{2,5}$, SO_2, NO_2, CO, VOCs
Honey processing unit	Trucks	TSP, PM_{10}, $PM_{2,5}$, SO_2, NO_2, CO, VOCs
Coffee anchor units	-	-
Extension centre	-	-

Unit	Potential Air Quality Sources	Pollutants
Coffee processing unit	Trucks	TSP, PM_{10}, $PM_{2,5}$, SO_2, NO_2, CO, VOCs
Coffee ancillary units	-	-
Controlled atmospheric storage	-	-
Individual quick frozen facility	-	-
Multi-chamber cold storage	-	-
Pre-cooling chambers	-	-
Cereals processing unit	Trucks	TSP, PM_{10}, $PM_{2,5}$, SO_2, NO_2, CO, VOCs
Cereals anchor units	-	-
Fruit ancillary units	-	-
Fruit anchor units	-	-
Vegetable anchor units	-	-
Vegetable ancillary units	-	-
Vegetable processing units	Solids handling, solid reduction and drying	TSP, PM_{10}, $PM_{2,5}$,
	Steam peeling, blanching and dehydrating	Odour
	Trucks	TSP, PM_{10}, $PM_{2,5}$, SO_2, NO_2, CO, VOCs
Poultry - egg storage unit	-	-
Poultry - egg processing unit	Trucks	TSP, PM_{10}, $PM_{2,5}$, SO_2, NO_2, CO, VOCs
Other animal products processing unit	Trucks	TSP, PM_{10}, $PM_{2,5}$, SO_2, NO_2, CO, VOCs
Meat - deep freeze cold storage	-	-
Meat anchor unit	-	-
Meat processing unit	Singeing, scalding, lairage, wastewater treatment and rendering	Odour, TSP, PM_{10}, $PM_{2,5}$
	Trucks	TSP, PM_{10}, $PM_{2,5}$, SO_2, NO_2, CO, VOCs
School	-	-
Crèche	-	-
Apartments	-	-
Retail space	-	-
Place of worship	-	-
Polyclinic	-	-
Substation	-	-
Truck lay bay	Trucks	TSP, PM_{10}, $PM_{2,5}$, SO_2, NO_2, CO, VOCs
Administrative building	-	-
Training centre	-	-

To assess the current baseline ambient air quality situation, dust fallout was conducted at five sites from the 23 September to 21 November 2017 (**Table 8-20** and **Figure 8-28**). Passive monitoring of SO_2 and NO_2 concentrations was also undertaken at the same sites for a 14 day period from 23 September to 07 October 2017. A summary of the installation and removal dates and times for each passive sampler are presented in **Table 8-21**.

As per the terms of reference, dust fallout monitoring was proposed to be undertaken for a three-month period. However, due to high rainfall experienced at the start of the project, the monitoring was delayed until September 2017, and as such, monitoring was limited to a two-month period. In addition, a number of constraints were also experienced over the monitoring period, including security issues, possible contamination of samples and other external factors. It is noted that DFO 4 could not be found when returning to site to collect and exchange the buckets.

Table 8-20: Coordinates of dust fallout and passive monitoring locations at Yirga Alem IAIP

Site	Coordinates	
	UTM N (m)	UTM E (m)
SNNP – DFO 1	745674.80	428369.15
SNNP – DFO 2	744435.82	428733.44
SNNP – DFO 3	743672.95	428081.59
SNNP – DFO 4	743305.50	427295.17
SNNP – DFO 5	427483.74	744497.06

Figure 8-28: Dust fallout and passive monitoring locations at Yirga Alem IAIP

Table 8-21: Passive sampling details for SNNP

Monitoring Site	Start Date	Start Time	End Date	End Time
SNNP – DFO 1	23 September 2017	11:10	07 October 2017	14:16

Monitoring Site	Start Date	Start Time	End Date	End Time
SNNP – DFO 2		11:55		14:39
SNNP – DFO 3		12:30		13:26
SNNP – DFO 4		09:50		14:58
SNNP – DFO 5		10:30		13:47

DUST FALLOUT MONITORING

Deposition of large (>10 µm) solid particles is a function of the airborne concentration and the particle gravitational speed. The monitoring of fugitive dust is therefore conducted principally by passive dust deposition gauges, whereby an open-mouthed container is partially filled with distilled water and exposed for a designated period of time. The container is then collected and the insoluble particles are removed by filtering the water and weighing, whilst the soluble particle mass is determined after evaporation of a sample of the filtered solution. This is a standardised sampling technique in South Africa, commonly referred to as 'bucket-monitoring' that was originally derived from the American Society for Testing and Materials standard method for collection and analysis of dust fallout (ASTM D1739).

The sampling equipment consists of a non-directional fallout bucket with a circular opening of 19 cm and a depth of 33 cm (ASTM D1739-98). The specifications are as close as possible (with available materials) to those recommended by the ASTM D1739-98 Standard. The low aspect ratio (i.e. the height to width ratio) is required to keep collected particulates in the bucket before they settle in the sample water that is treated with a small quantity of biocide to prevent algal growth. The ASTM method stipulates that the stand which supports the container needs to be two metres above the ground as there is a large variability in the concentration of particles subject to settling at heights less than two metres.

PASSIVE SAMPLING

Passive samplers do not involve the pumping of any air. Instead gases diffuse onto the surface of the sampler and adsorb onto filter material contained inside a collection cartridge. The rate of adsorption of the samplers is known and, with the recorded exposure period, a gas concentration can be calculated. **Figure 8-29** shows the adsorption process. Passive samplers are deployed for specific time periods to allow for adequate adsorption of the gas onto the sorbent material for analytical measurement, but to avoid saturation point or a result below the detection limit (BDL). Air flow along the central duct is at ~2 m/s with a temperature of 13°C and relative humidity of 70%. These are within the limits appropriate to the samplers (Radiello 2006).

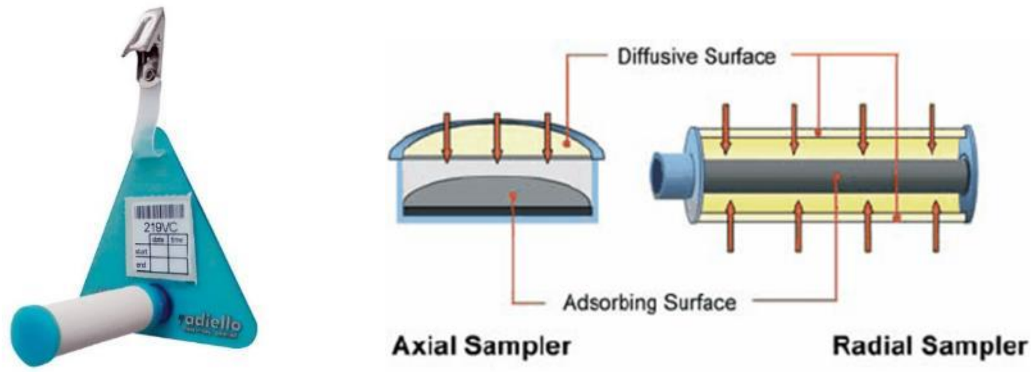

Figure 8-29: Diffusive and absorbing surfaces of a passive sampler

SENSITIVE RECEPTORS

The nearest town of Aposto is located approximately 1 km to the east of the SNNP Yirga Alem IAIP site (**Table 8-22**). Sensitive receptors located in close proximity to the site include subsistence farming and small homesteads.

Table 8-22: Sensitive receptors surrounding the SNNP Yirga Alem IAIP

Receptor	Distance	Direction
Aposto	~ 1 km	East
Yirga Alem	~ 5 km	East
Gado	~ 8 km	East Southeast
Cheichei	~ 14 km	North Northeast
Chuko	~ 14 km	South
Wendo	~ 15 km	South Southeast
Leku	~ 17 km	North Northeast

SITE ASSESSMENT RESULTS

DUST FALLOUT MONITORING

Dust fallout levels measured at the proposed site, from 23 September to 21 November 2017, are presented in **Table 8-23** and **Figure 8-30**. Dust fallout levels at all sites fell below the residential standard of 600 mg/m^2/day over both monitoring periods. Most of the area surrounding the proposed SNNP IAIP is shrubland land with few open exposed areas.

Table 8-23: Dust fallout levels measured at SNNP from 23 September – 21 November 2017

Site	Dust Fallout (mg/m^2/day)	
	October 2017	November 2017
SNNP – DFO 1	253.94	116.92
SNNP – DFO 2	112.26	436.41
SNNP – DFO 3	112.49	209.27
SNNP – DFO 4	-	288.14
SNNP – DFO 5	403.31	205.85
Note: - Dust fallout sampler missing due to vandalism on site.		

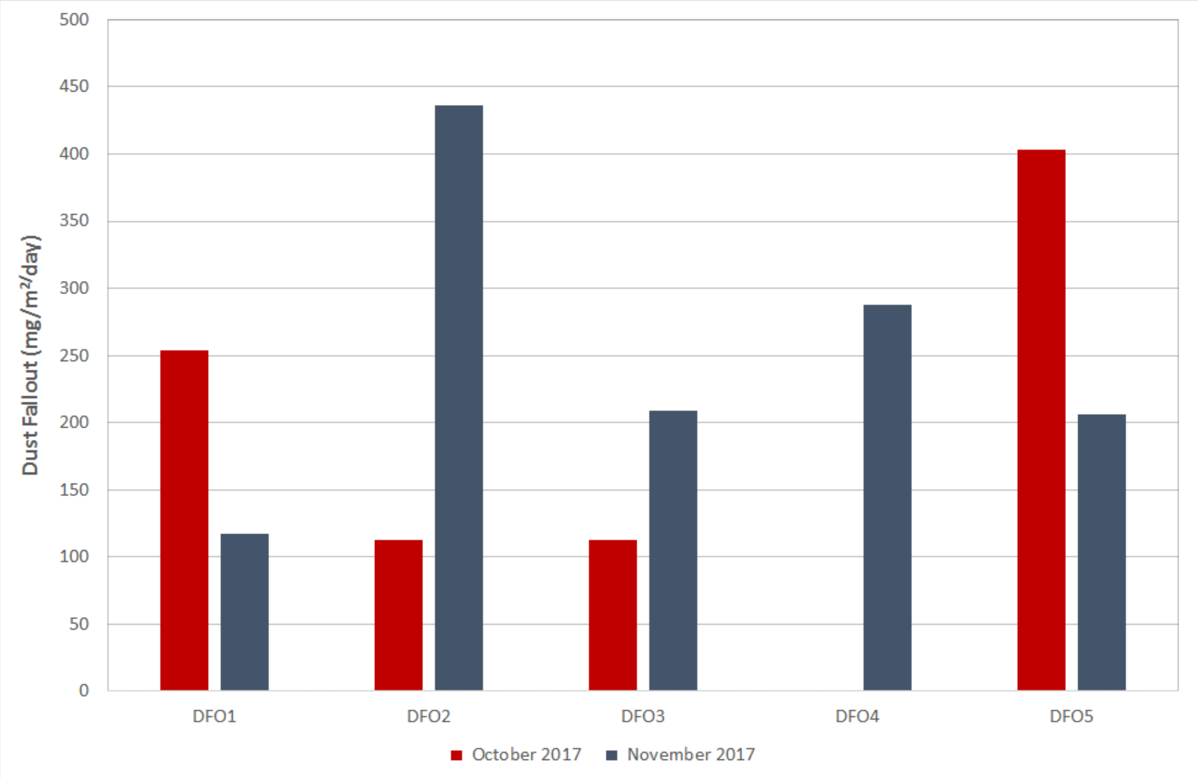

Figure 8-30: Dust fallout levels measured at SNNP from 23 September – 21 November 2017

PASSIVE SAMPLING

Ambient SO_2 and NO_2 concentrations measured at the proposed site in September/October 2017 are provided in **Table 8-24** and **Figure 8-31**. Concentrations were measured over a 14 period with concentrations compared with an annual average standard in the absence of a short-term standard. This approach is recognised to be environmentally conservative.

Measured ambient SO_2 and NO_2 concentrations fall below their respective WHO ambient air quality guidelines at all monitoring sites. The highest SO_2 and NO_2 concentrations were measured at DFO2 during the monitoring period.

Table 8-24: Ambient NO_2 and SO_2 concentrations measured at SNNP in September / October 2017

Site	NO_2 Concentration (µg/m³)	WHO Annual Average NO_2 Standard (µg/m³)	SO_2 Concentration (µg/m³)	WHO Annual Average SO_2 Standard (µg/m³)
SNNP – DFO 1*	6.30	**40**	0.87	**20**
SNNP – DFO 1	8.85	**40**	0.72	**20**
SNNP – DFO 2	27.69	**40**	3.68	**20**
SNNP – DFO 3	6.47	**40**	1.64	**20**
SNNP – DFO 4	3.54	**40**	2.97	**20**
SNNP – DFO 5	0.50	**40**	0.74	**20**
*Duplicate sample				

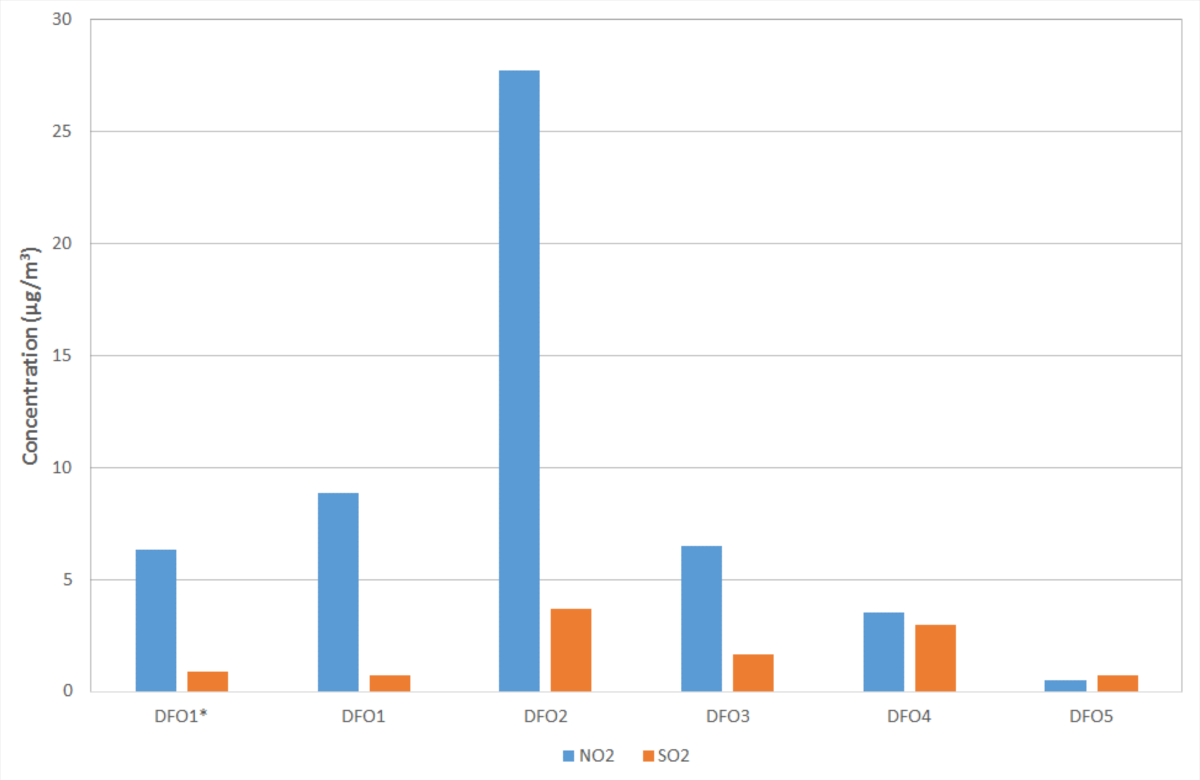

Figure 8-31: Ambient NO_2 and SO_2 concentrations measured at SNNP in September / October 2017

8.9.2 DILLA RTC

Based on the activities proposed at the RTC, it is anticipated that air quality impacts will be minimal and as such, a high-level assessment of the Dilla RTC site was conducted.

SENSITIVE RECEPTORS

The town of Dilla is located less than 1 km to the north of the SNNP RTC site. Other sensitive receptors located in close proximity to the RTC site include subsistence farming and small homesteads. **Table 8-22** identifies receptors surrounding the RTC site and the direction and distance from the sites

Table 8-25: Sensitive receptors surrounding the SNNP Yirga Alem IAIP

Receptor	Distance	Direction
Dilla	< 1 km	North
Gwangwa	~ 2 km	Southwest
Wenago	~ 7 km	Southwest
Uolabo	~9 km	Southeast
Kamadu	~10km	North Northeast

8.10 CLIMATE CHANGE

8.10.1 OVERVIEW

Climate change poses a huge challenge to Ethiopia's government and people. Home to 90 million people, it is one of the world's most drought-prone countries. The country faces numerous development challenges that exacerbate its vulnerability to climate change, including high levels of food insecurity and ongoing conflicts over natural resources. Chronic food insecurity affects 10% of the population, even in years with sufficient rains. Food insecurity patterns are linked to seasonal rainfall patterns, with hunger trends declining significantly after the rainy seasons.

Climate variability already negatively impacts livelihoods and is likely to continue. Drought is the single most destructive climate-related natural hazard in Ethiopia. Estimates suggest climate change may reduce Ethiopia's GDP up to 10% by 2045, primarily through impacts on agricultural productivity (Climate Risk Profile: Ethiopia). These changes also hinder economic activity and aggravate existing social and economic problems. **Figure 8-32** shows the climate classification in Ethiopia.

Historic climate trends since 1960 show that:

- Mean annual temperature has increased by 1°C, an average rate of 0.25°C per decade, most notably in July through September;
- The average number of "hot" nights (the hottest 10 percent of nights annually) increased by 37.5% between 1960 and 2003, while the average number of hot days per year increased by 20%;
- More intense precipitation during extreme weather events, although long-term rainfall trends are difficult to determine;
- Ethiopia has three rainy seasons: June–September (kiremt), October–January (bega), and February–May (belg). Kiremt rains account for approximately 50–80% of the annual rainfall totals, and most severe droughts usually result from failure of the kiremt. The lowlands in the southeast and northeast are tropical, with average temperatures of 25°–30°C, while the central highlands are cooler, with average temperatures of 15°–20°C. Lowlands are vulnerable to rising temperatures and prolonged droughts, while highlands are prone to intense and irregular rainfall;
- The incidence of drought has hence increased; and
- Belg rains are increasingly unpredictable.

Future projections of temperature and rainfall patterns in Ethiopia exhibit a high degree of uncertainty, but most projections predict that:

- Mean annual temperature is projected to increase by between 1°–2°C by 2050;
- The frequency of hot days and nights will substantially increase. About 15–29 percent of days will be considered hot by 2060;
- It is uncertain whether rainfall will increase or decrease; projections range from -25% to +30% by the 2050s; and
- Increases in the proportion of total rainfall that falls in "heavy" events with annual increases of up to 18%.

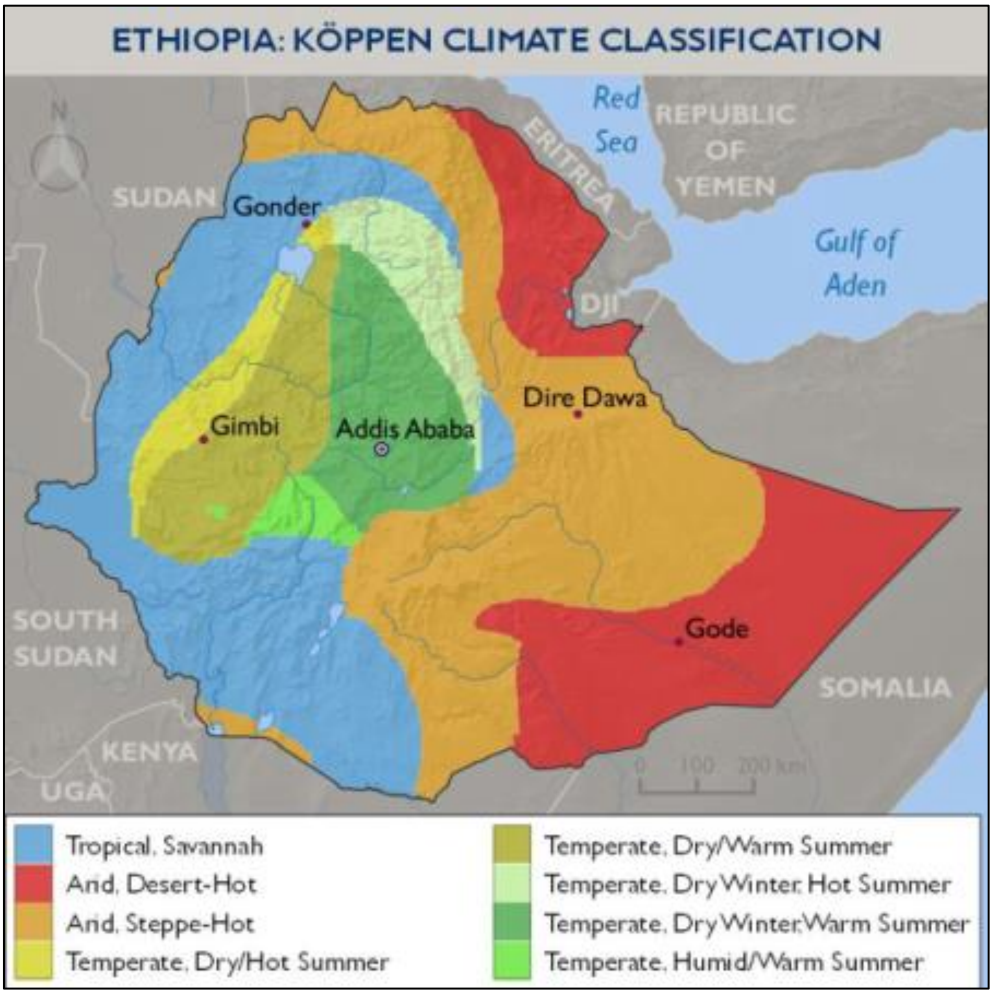

Figure 8-32: Climate classification of Ethiopia (Climate Risk Profile: Ethiopia)

Climate change will have key impacts on agriculture, livestock, water and human health in Ethiopia. In particular, this will result in:

- Reduced yields and/or crop failure, reduced soil moisture availability; and increased evapotranspiration and water stress;
- Increased incidence of pests and diseases, reduced feed and water sources, and increased livestock mortality;
- Changing ranges of vector-borne diseases and increased risk from waterborne diseases;
- Reduced water quality and quantity, drying of wetlands and freshwater sources, disruption of hydropower generation;
- Changing ranges of vector-borne diseases; and
- Increased risk from waterborne diseases.

Despite the challenges, Ethiopia hopes to capitalise on its current economic growth by becoming more resilient to the impacts of climate change while developing its economy in a carbon neutral way by transforming development planning, investments and outcomes.

The country's Climate Resilient Green Economy Strategy (CRGE), which was published in 2011, sets out this vision (International Institute for Environment and Development). It is viewed as an opportunity to transform the country's development model by leaping to modern energy-efficient development trajectories.

Ethiopia is one of the few countries to have formally merged its aims of developing a green economy and greater resilience to climate change under a single policy framework in support of its national development objectives. While the government is still preparing its climate resilience objective, the

Green Economy component of the CRGE has already been developed (International Institute for Environment and Development). It aims to develop Ethiopia's green economy by:

- Improving crop and livestock production practices to improve food security and increase farmer's incomes while reducing emissions;
- Protecting and re-establishing forests for their economic and ecosystem services, including as carbon stocks;
- Expanding electricity generation from renewable energy sources for domestic and regional markets; and
- Advancing to modern and energy-efficient technologies in transport, industrial sectors, and buildings.

Greenhouse gas emissions in Ethiopia increased by 86% from 1993 - 2011. Through the Intended Nationally Determined Contribution, Ethiopia pledges to cap 2030 greenhouse gas emissions at 145 MtCO2e, a 64% reduction from projected business as usual emission levels in 2030. The pledge includes greenhouse gas reductions from agriculture, forestry, industry, transport and buildings sectors.

8.10.2 GREENHOUSE GAS ASSESSMENT

EMISSION FACTOR APPROACH

Default IPCC emission factors available in the 2006 IPCC Guidelines have been used to calculate emissions from activity data

EMISSION CATEGORIES

GHG emission activities are divided into three scopes within the Greenhouse Gas Protocol Corporate Accounting and Reporting Standard, defined as:

- **Scope 1**: Direct emissions arise from activities owned or controlled by an organisation, such as emissions from combustion in boilers, furnaces, and vehicles operating onsite. In the case of Project, this refers to emissions associated with the internal combustion engines for transport vehicles;
- **Scope 2**: Indirect emissions released into the atmosphere associated with the consumption of purchased electricity, heat, steam and cooling; these emissions occur at a distance from the site (e.g. at a power plant). In the case of the Project, this refers to GHG emissions due to their electricity consumption onsite; and
- **Scope 3**: Other indirect emissions, other than those associated with energy usage, including business travel by means not owned or controlled by the entity, waste disposal by means not owned or controlled by the entity, and extraction/production and transport of purchased materials or fuels.

For the purposes of this assessment Scope 3 emissions have been excluded, with the exception of electricity consumption emissions. The assessment therefore focuses only on those activities occurring on site.

A GHG, as defined by the IPCC, is a compound which has the ability to trap heat over a certain lifetime in the atmosphere. The six priority pollutant GHGs are CO2, CH4, N2O, HFCs, PFCs and SF6.

The key GHG emissions associated with activities at the facility include:

- CO_2;
- CH_4; and
- N_2O.

The impact of these GHGs are quantified using their Global Warming Potential (GWP), which is a measure of their heat trapping effect relative to the effects of the same weight of CO_2 released over

the same period of time. It is important to consider the GWP of GHG's, given that minor emissions of a high GWP gas could make a significant contribution to a carbon footprint. GHG emissions are therefore usually expressed in CO_2 equivalent terms (CO_{2eq}) to reflect the contribution of the various GHG emissions. **Table 8-26** shows the heat trapping ability of the major GHGs after 20 years and 100 years as compared to CO_2.

Table 8-26: Global Warming Potential of greenhouse gases

Greenhouse Gas	GWP after 20 years	GWP after 100 years
CO2	1	1
CH4	72	25
N2O	289	298

IPCC default factors have been applied for coal consumption for the coal-fired boiler and electricity generation to estimate CO_2 emissions. The emission factors as applied in this inventory are presented in **Table 8-27**, with the coal consumption data presented in **Table 8-28**.

Table 8-27: Greenhouse gas emission factors

Scope	Source	Emission Factor Unit	CO_2	CH_4	N_2O
Scope 1	Coal consumption	Kg per GJ	94.6	0.001	0.0015
Scope 2	Electricity generation using coal	Kg per GJ	94.6	0.001	0.0015

Table 8-28: Coal consumption data

Scope	Source	Main Activity	Unit	Quantity / Annum
Scope 1	Coal consumption	Coal-fired boiler operations	MJ/s	10
Scope 2	Electricity consumption IAIP	Coal-fired operations	MVA	42.58
	Electricity consumption RTC	Coal-fired operations	MVA	1.157

8.11 GREENHOUSE GAS EMISSIONS

The total GHG emissions for the Yirga Alem IAIP site was calculated to be approximately 161 113.77 t CO2eq based on the above approach. For the assessment a worst case scenario approach was calculated whereby all electricity required for the sites is generated via coal-fired operations. As such Scope 2, coal-fired operations, was shown to contribute the highest GHG emissions to be emitted in terms of the SNNP Project (making up approximately 81% of the total GHG emissions emitted). CH_4 and N_2O emissions are marginal from all sources, being significantly over shadowed by CO_2 emissions which account for 99.5% of total CO_2eq emissions associated with the SNNP Project activities (**Table 8-29** and Figure 8-33).

Table 8-29: Estimated greenhouse gas emissions for the SNNP IAIP and RTC

Scope	Source	Main Activity	CO_2 (tons/year)	CH_4 (tons/year)	N_2O (tons/year)	CO_2e (tons/year)
Scope 1	Coal consumption	Coal-fired boiler operations	29833.06	7.88	140.97	29981.91
Scope 2	Electricity generation at IAIP	Coal-fired operations	127 029.15	33.57	600.23	127 662.96

Scope	Source	Main Activity	CO_2 (tons/year)	CH_4 (tons/year)	N_2O (tons/year)	CO_2e (tons/year)
	Electricity generation RTC	Coal-fired operations	3 451.68	0.91	16.31	3 468.91
TOTAL GHG EMISSIONS						**161 113.77**

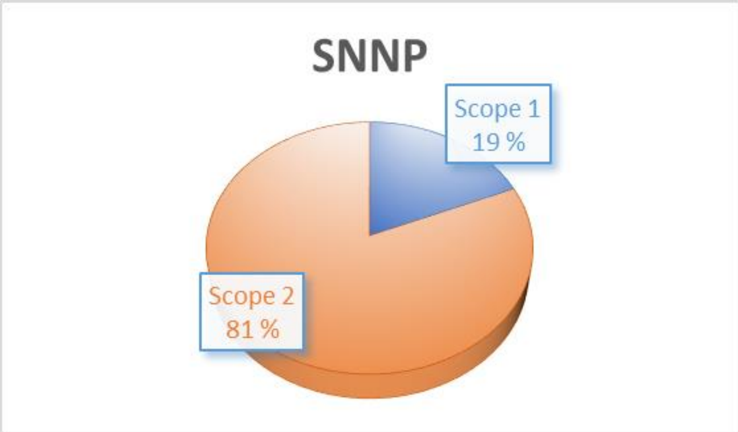

Figure 8-33: CO_{2eq} percentage contribution from Scope 1 and Scope 2 sources at SNNP

It is important to note that according to the Ethiopian Electric Power Corporation (EEPCo), Ethiopia's total electricity generation in 2010 was 3,981.07 GWh. Hydropower generates approximately 88% of the total electricity generation and is thus the country's dominating electricity resource, followed by Diesel (11%) and geothermal (1%) electricity generation.

It is therefore noted that the total greenhouse gas emissions estimated for the Project are considered a worst case scenario. Should the IAIP and RTC facilities be provided electricity from the national grid the greenhouse gas emissions resulting from the generation of the required electricity is drastically reduced (in the region of 80% reduction) due to the use of renewable resources as the predominant energy source for the generation of electricity.

8.12 NOISE

This section describes the receiving environment in terms of Noise within the Project site and surrounding area.

8.12.1 YIRGA ALEM IAIP

The current noise climate is typically rural, with very limited anthropogenic influences. The site currently consists of agricultural activities, mixed vegetation and low density settlements, all of which do not generate significant levels of noise.

NOISE MONITORING METHODOLOGY

In order to assess the current noise climate in the vicinity of the Yirga Alem IAIP, ambient environmental acoustic monitoring was undertaken on 16 August 2017 at six locations in and around the proposed site (**Table 8-30** and **Figure 8-34**).

Table 8-30: Noise monitoring locations

ID	Classification	Coordinates	
		UTM N (m)	UTM E (m)
S_01	Residential	745176.22 m N	428518.26 m E
S_02	Residential	744435.60 m N	428871.49 m E
S_03	Residential	743703.19 m N	428121.20 m E
S_04	Residential	743289.33 m N	427257.58 m E
S_05	Residential	744095.02 m N	427599.40 m E
S_06	Residential	745005.52 m N	428186.92 m E

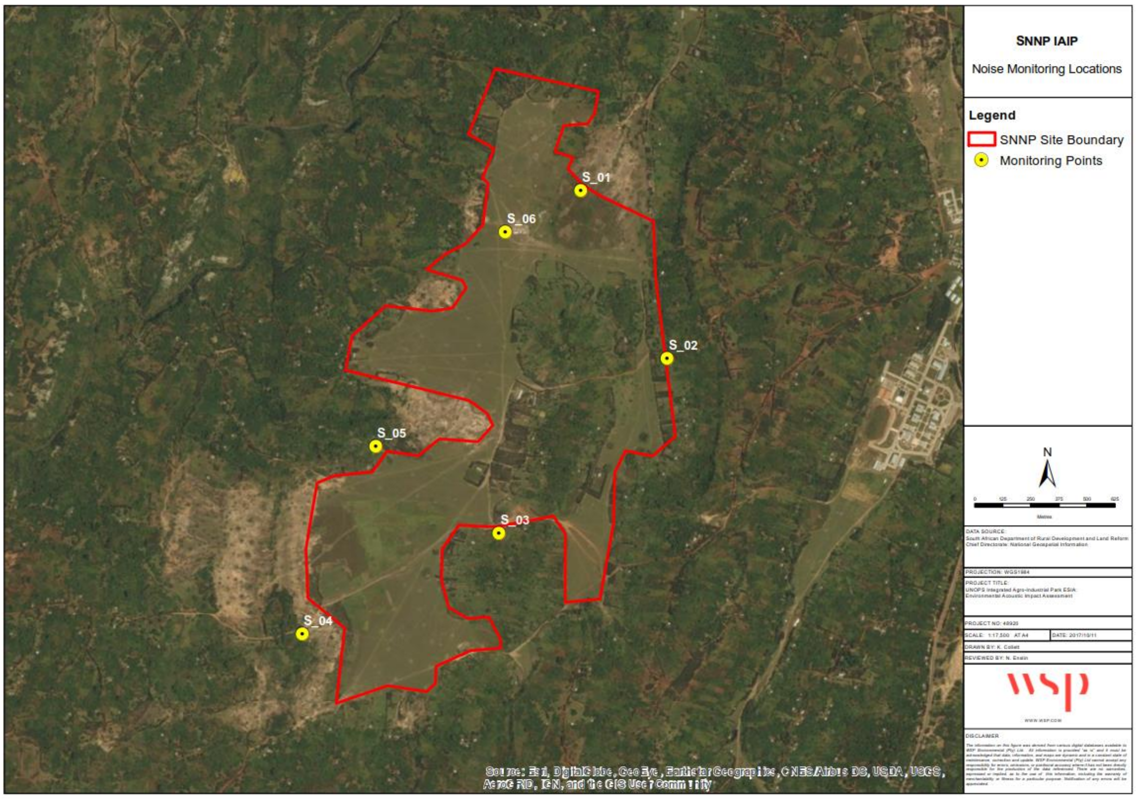

Figure 8-34: Noise monitoring locations surrounding the Yirga Alem IAIP

All sound level measurements were free-field measurements (i.e. at least 3.5 m away from any vertical reflecting surfaces). Measurement procedures were undertaken according to the relevant South African Code of Practice SANS 10103:2008 which is in line with the IFC requirements. This guides the selection of monitoring locations, microphone positioning and equipment specifications. Sound level measurements were taken with a SABS-calibrated Type 1 Integrating Sound Level Meter. The sound level meter was calibrated before and after measurements were conducted and no significant drifts (differences greater than 0.5 dB(A)) were found to occur. The make and model as well as serial number and calibration validity of the sound level meter and calibrator are presented in **Table 8-31**.

Table 8-31: Sound level meter and calibrator specifications

Sound level meter	Calibrator
Make & model: CEL 63X	Make & model: CEL-120/1
Serial number: 3134723	Serial number: 3939145
Date calibrated: November 2016	Date calibrated: November 2016

Sound level meter	Calibrator
Calibration due date: November 2017	Calibration due date: November 2017

Day-time and night-time measurements were conducted for fifteen minutes, allowing monitoring to be adequately representative. In accordance with the IFC EHS Guidelines, monitoring was conducted during the relevant timeframes for day (07:00 to 22:00) and night (22:00 to 07:00).

The noise parameters recorded included:

- L_{Aeq} The equivalent continuous sound pressure level, normally measured (A-weighted);
- L_{Amax} The maximum sound pressure level of a noise event measured (A-weighted);
- L_{Zpeak} The peak noise level experienced during the measurement (Z-weighted); and
- L_{A90} The average noise level the receptor is exposed to for 90% of the monitoring period.

DAY-TIME MONITORING RESULTS

The results from the day-time noise monitoring campaign conducted on 16 August 2017 are presented in **Table 8-32** and **Figure 8-35**. Noise levels were compared to the typical day-time guideline level for noise in residential areas (55 dB(A)). Noise levels at all six monitoring locations were well below the guideline level. The highest noise levels were recorded at S_04, located on the south-western boundary of the proposed site. Dominant noise sources at this location included livestock and distant traffic.

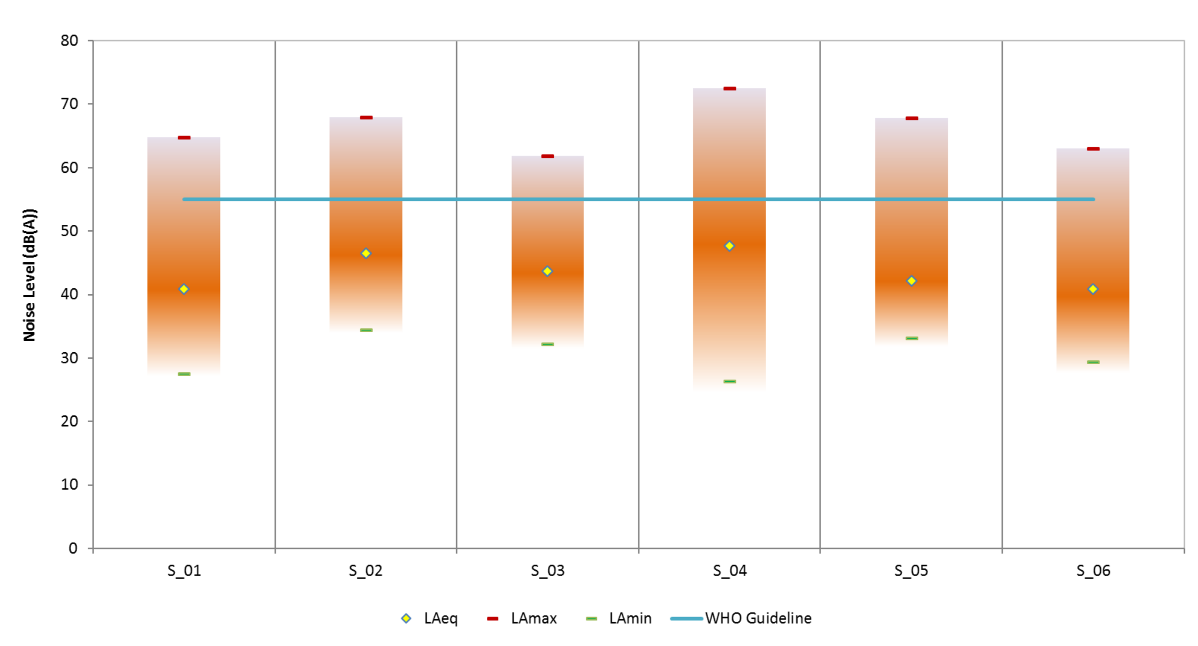

Figure 8-35: Day-time monitored noise levels. LAeq (yellow diamond) is compared with the WHO guideline

Table 8-32: Day-time noise monitoring results

Location	Time	L_{Aeq} (dB(A))	L_{Amax} (dB(A))	L_{Amin} (dB(A))	WHO Guideline (dB(A))	Compliant
S_01	14:42	40.9	64.8	27.5	55	Yes
S_02	15:23	46.5	67.9	34.5	55	Yes
S_03	12:26	43.7	61.9	32.2	55	Yes

Location	Time	L_{Aeq} (dB(A))	L_{Amax} (dB(A))	L_{Amin} (dB(A))	WHO Guideline (dB(A))	Compliant
S_04	12:55	47.7	72.5	26.4	55	Yes
S_05	13:48	42.2	67.8	33.2	55	Yes
S_06	14:16	40.9	63.0	29.4	55	Yes

NIGHT-TIME MONITORING RESULTS

The results from the night-time noise monitoring campaign conducted on 16 August 2017 are presented in **Table 8-33** and **Figure 8-36**. Noise levels were compared to the typical night-time guideline level for noise in residential areas (45 dB(A)). Noise levels at all six monitoring locations were below the guideline level. The highest noise levels were recorded at S_05, located on the western boundary of the proposed site. Dominant noise sources at this location included hyenas and distant traffic.

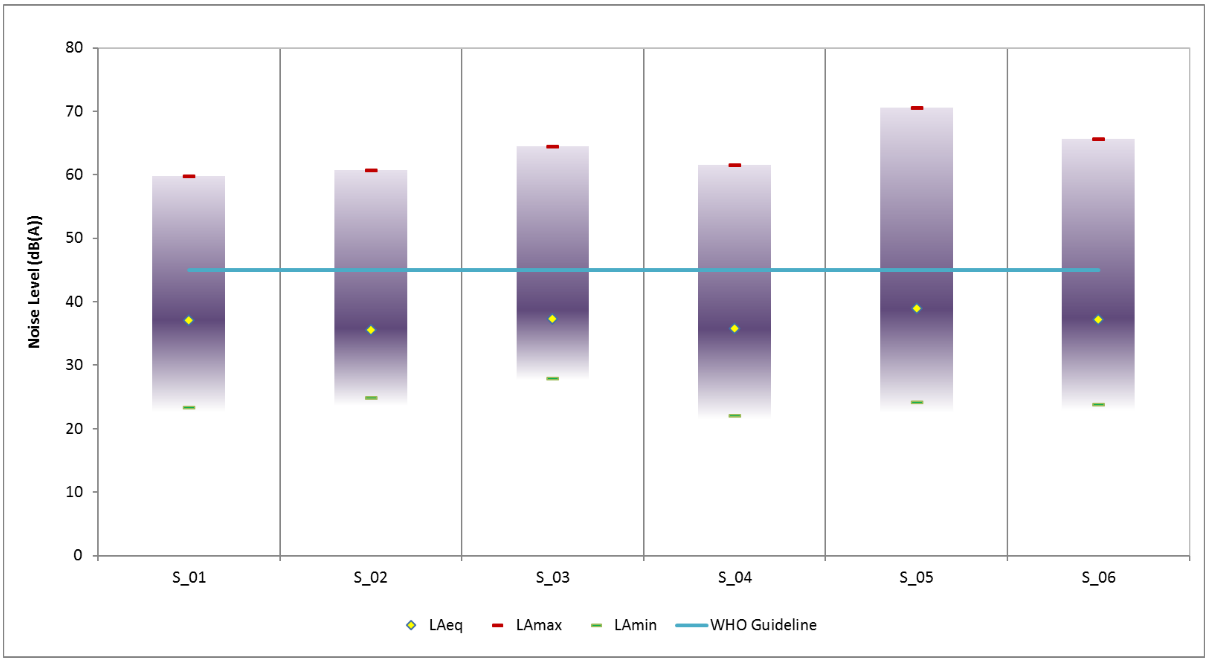

Figure 8-36: Night-time monitored noise levels. L_{Aeq} (yellow diamond) is compared with the WHO guideline.

Table 8-33: Night-time noise monitoring results

Location	Time	L_{Aeq} (dB(A))	L_{Amax} (dB(A))	L_{Amin} (dB(A))	WHO Guideline (dB(A))	Compliant
S_01	00:00	37.1	59.8	23.4	45	Yes
S_02	00:25	35.6	60.7	24.9	45	Yes
S_03	22:17	37.3	64.5	27.9	45	Yes
S_04	22:43	35.8	61.6	22.1	45	Yes
S_05	23:13	38.9	70.6	24.2	45	Yes
S_06	23:39	37.2	65.7	23.8	45	Yes

SENSITIVE RECEPTORS

Sensitive receptors are identified as areas that may be impacted negatively due to noise associated with the construction and operation of the proposed IAIP site. Examples of receptors include, but are not limited to, schools, shopping centres, hospitals, office blocks and residential areas. The nearest town of Aposto is located approximately 1 km to the east of the SNNP IAIP site. Other sensitive receptors located in close proximity to the IAIP site include subsistence farming and small homesteads.

As noise is greatly attenuated over distance, those receptors located further than 1 km from the site will not be impacted on by activities at the IAIP. In terms of this Environmental Acoustic Impact Assessment, impacts on the surrounding homesteads located within 500 m to 1 km of the site are a focus.

CONSTRUCTION PHASE ASSESSMENT

Detailed construction plans for the entire IAIP development have not yet been developed and as such a generic construction situation was assessed for the IAIP site based on previous experience with construction phase acoustics. **Table 8-34** presents a list of potential construction equipment that will be utilised during the construction of IAIP site as well as the sound power level (PWL) specifications of the equipment (BSI, 2009). Construction will be erratic in nature with no set locations for equipment at a given time. In order to represent a worst-case scenario, it is assumed that one of each piece of equipment will be operational simultaneously at any location within the IAIP site. Such a worst-case scenario is unlikely to occur in reality. The sum (logarithmic) of the PWLs from all noise sources was utilised to calculate resultant noise levels at specified distances from the IAIP site. Such resultant receptor noise levels were calculated using attenuation-over-distance acoustic calculations.

Table 8-34: Construction phase equipment and sound power level ratings

Equipment	Sound Power Level (dB(A))
Excavators	101.0
Tipper Trucks	108.0
Graders	111.0
Bulldozers	111.0
Front end loaders	104.0
Rollers	101.0
Concrete Mixers	107.0
Generators	102.0
Logarithmic Total	**116.3**

OPERATIONAL PHASE ASSESSMENT

A high-level, semi-quantitative assessment of the potential sources and impacts associated with the IAIP site has been undertaken, based on the proposed site layout plan. Sound power level specifications for potential operational equipment was sourced from literature and subsequently used as a basis for attenuation-over-distance calculations in order to determine worst-case operational noise levels.

Table 8-35 presents all the proposed production units within the IAIP as well as potential significant sources of noise within each unit. It is anticipated that most units will not have significant sources of noise, with the sewage treatment plant; solid waste management plant; boiler, chiller and compressor; and the meat processing unit generating the largest amount of noise. The meat processing unit, with anticipated noise sources being fans, rotary meat saws, compressors and pumps is envisaged to be the noisiest unit.

Table 8-35: List of various IAIP units and associated significant noise sources

Unit	Potential Significant Noise Sources	Sound Power Levels (dB(A))
Sewage treatment plant	Pumps	104.0
	Compressors	102.0
	Fans	98.0
Solid waste management plant	Trucks	85.0
	Conveyors	101.0
	Loading equipment	90.0
	Compactors	92.0
Boiler, chiller & compressor	Boiler	98.0
	Compressors	102.0
Milk & Dairy Plant	Trucks	85.0
	Homogenizer	82.0
	Centrifuges	73.0
	Filling and packing machinery	90.0
Poultry - egg storage unit	-	-
Honey processing unit	-	-
Coffee anchor units	-	-
Extension centre	-	-
Coffee processing unit	-	-
Coffee ancillary units	-	-
Controlled atmospheric storage	-	-
Individual quick frozen facility	Compressors	102.0
Multi-chamber cold storage	Compressors	102.0
Pre-cooling chambers	Compressors	102.0
Cereals processing unit	-	-
Cereals anchor units	-	-
Fruit ancillary units	-	-
Fruit anchor units	-	-
Vegetable anchor units	-	-
Vegetable ancillary units	-	-
Vegetable processing units	-	-
Poultry - egg processing unit	Compressors	102.0
Other animal products processing unit	-	-
Meat - deep freeze cold storage	Compressors	102.0
Meat anchor unit	-	-
Meat processing unit	Fans	98.0

Unit	Potential Significant Noise Sources	Sound Power Levels (dB(A))
	Rotary Saws	100.0
	Compressors	102.0
	Pumps	104.0
School	-	-
Crèche	-	-
Apartments	-	-
Retail space	-	-
Place of worship	-	-
Polyclinic	-	-
Substation	-	-
Truck lay bay	-	-
Administrative building	-	-
Training centre	-	-

8.12.2 DILLA RTC

The proposed Dilla RTC site is located approximately 4 km south of the town of Dilla and abuts the federal highway no.8 (Shashemene to Hagere Mariam), along the western boundary. The site is surrounded by agricultural land, and low to medium density residential areas. The area around the site is densely vegetated however mostly consists of various types of agricultural crops including coffee, avocados, mangoes, bananas and pineapples amongst others. There is a higher concentration of residential dwellings adjacent to the highway however dwellings are scattered in the area surrounding the site. There is also an Orthodox Church (St. Gabreal)) situated in close proximity to the site (i.e. approximately 200m south of the site).

With limited associated noise sources, it is anticipated that acoustic impacts from the Dilla RTC site will be negligible and as such an acoustic assessment of the RTC site has not been conducted.

8.13 TRANSPORT / ACCESS

8.13.1 YIRGA ALEM IAIP

ROAD NETWORK

The local road network primarily consist of Federal Highway No. 8, which is a single carriageway surfaced road, with 1 lane per direction in the vicinity of the future access road. The Hawassa-Dilla portion of Federal Highway No. 8 is part of the Addis Ababa-Moyale-Nairobi-Mombasa Corridor. Refer to **Figure 8-37** for an image of the existing federal highway no. 8 running through Aposto.

Figure 8-37: Image of federal highway no. 8 running through Aposto

The Aposto-Dilla section of the highway has high traffic volumes and is reportedly in a poor condition and has served its design life. Road upgrading is currently underway as part of the Hawassa – Hagere Maryam upgrading project. This involves upgrading to DS3 standard of the Ethiopian Roads Authority (ERA) Design Manual, namely widening of the existing road to a 7 m carriageway and 1.5 m shoulders on both sides.

The highway will be suitable to provide vehicle access and connectivity to the development, if it is in a good condition along its full length and pending the provision of the direct local access road. The access location must take cognisance of vehicle and Non-motorised transport (NMT) safety.

It is noted that the condition of federal highway no. 8 was not assessed, therefore sections of this or other access roads to the IAIP may currently be in a poor condition, dangerous or partially impassable, for example the roadway width is reduced. The additional traffic due to the IAIP could therefore increase the road safety risks and accident potential in these areas.

The existing access road to the IAIP site is a dirt road, with 1 lane per direction, which covers a distance of 3km from Aposto to the site (**Figure 8-38**). There are nine roads (4 asphalt and 5 dirt roads) that connect Yirga Alem to other surrounding towns in different directions.

Figure 8-38: Existing access road to the IAIP site

EXISTING TRAFFIC FLOWS

Current road traffic volume on the access road is low but this is expected to increase at the peak of multiple construction and operation activities as a result of the IAIP.

Sample traffic counts were undertaken by MACE along the Federal Highway A3 near the existing IAIP access road. The sample traffic survey was conducted for two hours to estimate the daily traffic load of the Federal Highway no. 8. From this survey the daily traffic load is estimated to be 4,824 (excluding the two wheelers) which is slightly less than the Annual Average Daily Traffic (AADT) summary of 4,910 vehicles measure in 2015 by the ERA.

According to the Yirga Alem town municipality officials reported traffic accidents are increasing. Furthermore, the occurrence of road accident deaths for the current year is currently at 3 while there was only 1 death resulting from road accidents in the previous year.

ROAD NETWORK MASTER PLANNING

There are no known new or additional local roads or federal highways planned in the vicinity of the IAIP study area, other than the proposed IAIP access road as described below.

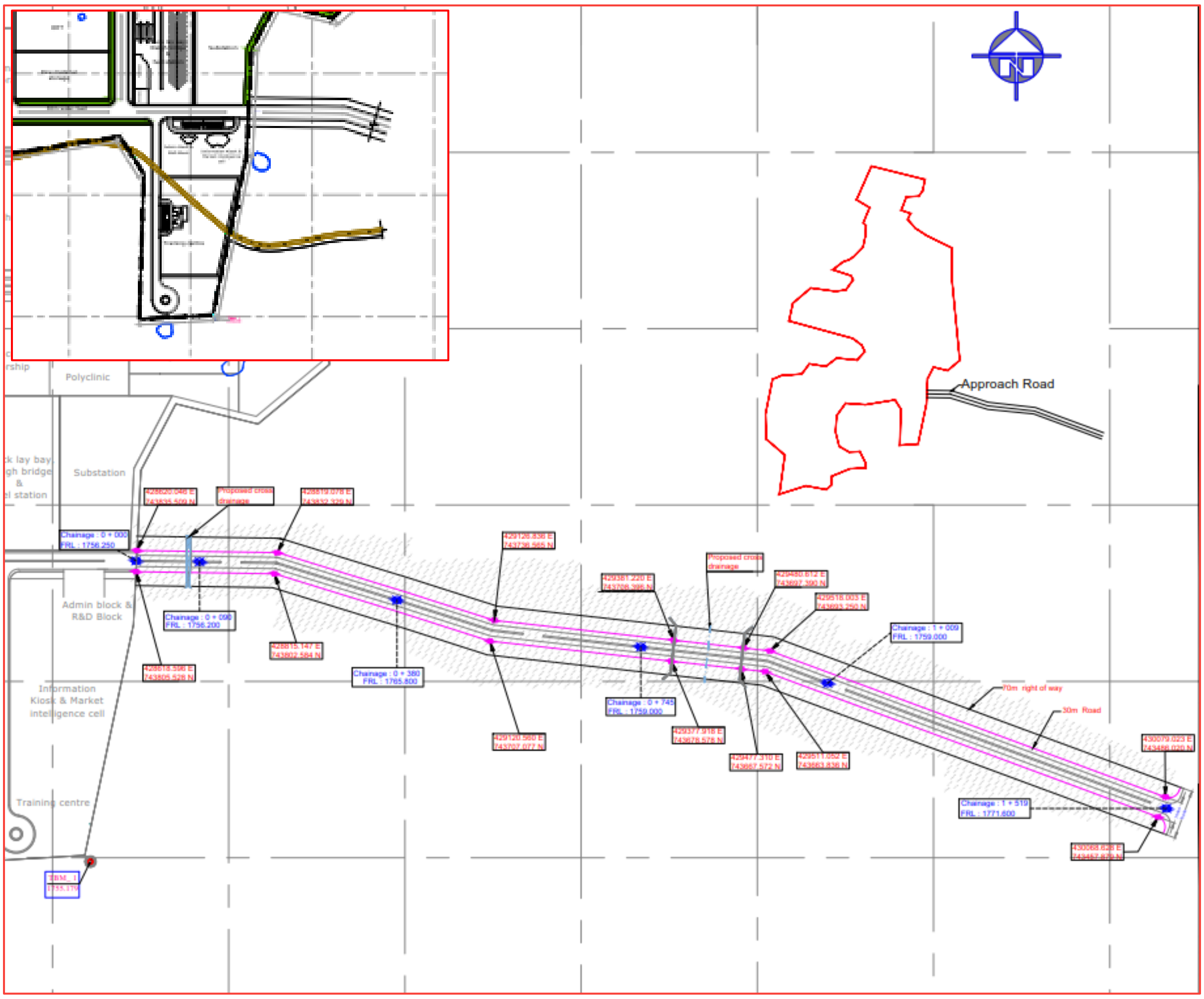

Figure 8-39: proposed access road alignment (Source: MACE Drawing No. MACE-P942-ESNNP-YA-ER-005)

Figure 8-40: Road network associated with the Yirga Alem IAIP

8.13.2 DILLA RTC

ROAD NETWORK DESCRIPTION

The proposed RTC is located adjacent to the federal highway no.8 which is part of the Cairo-Cape Town Trans-African Highway. The highway is a single carriageway, surfaced, with 1 lane per direction and no shoulders. Entrance to the RTC is to be obtained directly off the highway via two main gates located on the western boundary of the site.

The Dilla-Wonago road is part of the road rehabilitation programme of Hawassa – Ageremariam Road by the FDRE. The Hawassa – Ageremariam section of the road will be upgraded according to DS3 standard of the ERA Design Manual. It involves the widening of the existing road which has an average carriageway width of 5.5m and 0.5m shoulders on both sides, to a 7.0m carriageway and 1.5m shoulders on both sides in flat and rolling sections or 7.0m carriageway and variable shoulders in mountainous/escarpment sections. Besides this the regional government has plans to construct new roads and maintaining the existing roads in the Dilla area which will have a meaningful contribution to the road network in the Dilla RTC study area.

It is noted that a new section of the federal highway has been constructed west of the current alignment to direct traffic around the centre of Dilla. The new section of the highway starts at a point approximately 500 m south of the RTC site. As such, vehicles transporting goods to and from the RTC will not have to pass through the centre of the town of Dilla.

The highway is suitable to provide vehicle access and connectivity to the development, pending the provision of safe access side-road intersections that takes cognisance of vehicle and Non-motorised transport (NMT) safety.

Important note, the condition of federal highway no. 8 was not assessed, therefore any areas of this or other access road to the RTC may currently be in a poor condition, dangerous or partially impassable; for example the roadway width is reduced. The additional traffic due to the RTC could therefore increase the road safety risks and accident potential in these areas.

Figure 8-41 shows the Dilla RTC site in relation to the existing highway and new highway section. **Figure 8-42** provide photographs of the highway directly adjacent to the RTC site in a northerly and southerly direction.

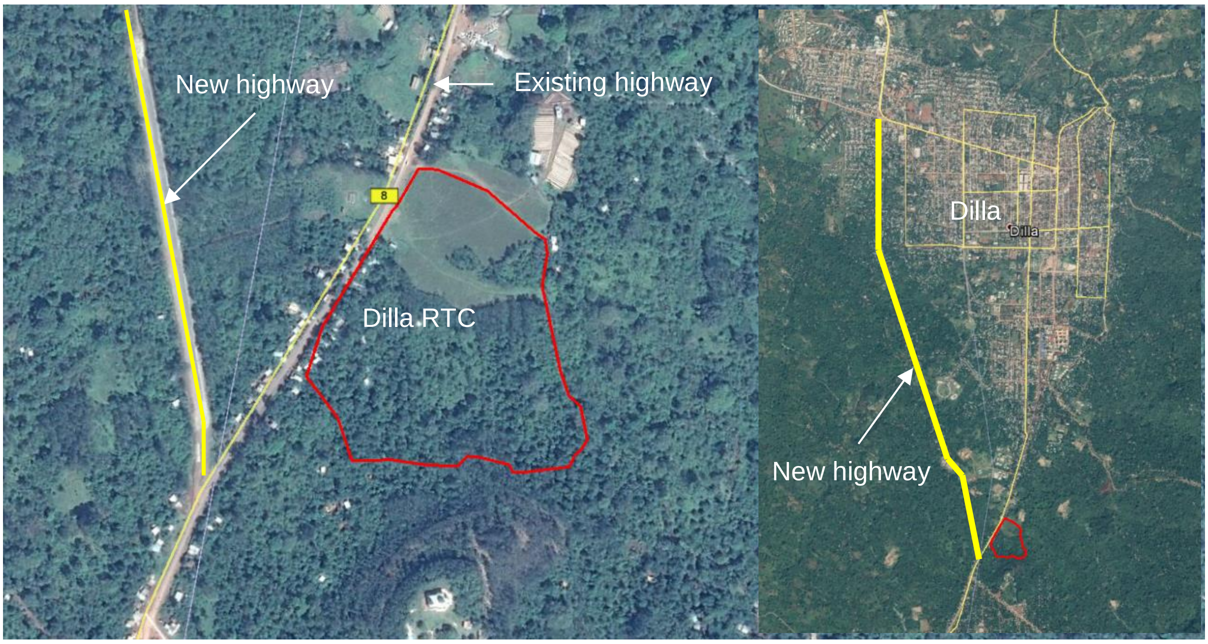

Figure 8-41: Alignment of the new section of Federal Highway 8 in the vicinity of the RTC

Figure 8-42: Image of highway No. 8 in vicinity of Dilla access (southerly and northerly direction)

EXISTING TRAFFIC FLOWS

ERA data of 2016 states that the AADT on Federal Highway no. 8 on the Dilla-Wonago section is estimated to be 1,570 vehicles.

ROAD NETWORK MASTER PLANNING

There are no known new or additional local roads or federal highways planned in the vicinity of the RTC study area.

8.14 WASTE

8.14.1 YIRGA ALEM IAIP

The main town in close proximity to the Yirga Alem IAIP is Yirga Alem towns. Yirga Alem town is close to the IAIP site (approximately 6 km). Therefore, the towns' current solid and liquid waste management practices were assessed in order to gain adequate baseline information for the possible environmental impact assessment and mitigation measures.

CURRENT WASTE MANAGEMENT OF YIRGA ALEM TOWN

SOLID WASTE MANAGEMENT

Generation, Collection and Transportation

Solid waste management of Yirga Alem town is very much similar to many towns in Ethiopia. Solid waste management activities associated with generation, storage, collection, transportation, processing and safe disposal are not properly established. Solid waste is collected in bulk and disposed of at an open unregistered dumpsite on the outskirt of the town without any form of pre-treatment or formal management.

There are eight SMEs in Yirga Alem with a combined membership of eighty individuals that are involved in primary door to door waste collection. This collection is undertaken utilising approximately ten donkey-pull carts. The municipality has two tractors for waste collection from the temporary waste transfer stations (containers) to the waste disposal dumpsite. The daily collection is estimated to be 100-150m^3. According to the 2015 assessment report (Thornton, 2015), the average daily per capita generation of solid waste of the town is about 0.26 kg. During the ESIA team consultation with the relevant municipal officials, it was identified that that the solid waste generation rate of the town is increasing as a result of the growing economic activities. There is one association in the town which is involved in small scale composting of organic wastes. The organic wastes are mainly collected by the association from residential and commercial areas of the town.

Waste Disposal

An informal waste dumpsite is located approximately 1 km away from the centre of Yirga Alem town at *Bulbulcho,* on the way to Aposto. The dumpsite is not fenced nor has any lining. There is no formal waste treatment facility or management practice at the dumping site, however there are some individuals (scavengers) who have been involved in informal waste recovery and recycling activities.

Associated Solid Waste Management Plan

Based on the town’s structural plan, the municipality has aimed to initiate the construction of a new solid waste disposal site in the coming fiscal year 2017/18. According to the plan a proposed new disposal site will be located approximately 6km from the Yirga Alem town centre, along the Aposto-Dilla road in the neighbouring Woreda *(Dale Woreda).* It is noted that the proposed site is very close to the IAIP site. It is understood that an environmental and social safeguard study will be conducted of the new disposal site prior to its construction. According to the structural plan, the proposed dumpsite is being promoted by the municipality with involvement of the local environmental protection office.

LIQUID WASTE MANAGEMENT

The liquid waste management practice of the town is very limited. The town lacks an adequate drainage system for greywater and the municipality does not have vacuum truck for suction of faecal sludge from individual septic tanks. According to the municipality officials, an estimated 15,000 - 18,000m^3 liquid waste is generated annually from households and commercial institutions, but only 2,000-3,000m^3 of liquid waste is disposed of at the informal liquid waste disposal site. The waste disposal site is a simple dumping site assigned by the municipality without any form of treatment. Whenever there is a need for suction of septic tank sludge, individuals hire a vacuum truck from neighbouring towns such as Hawassa. The collected sludge is disposed of in the dumpsite located approximately 200 m from the solid waste disposal site at *Bulbulcho*.

The municipality had initiated a project that involved the construction of a new liquid waste disposal site with the support of the World Bank, however this project has unfortunately been terminated as a result of potential pollution impacts on the nearby institutions. The municipality is now looking for an alternative site as per the master plan of the town to construct a liquid waste disposal facility.

8.14.2 DILLA RTC

The Dilla RTC is located at the south-eastern outskirt of Dilla town along the Dilla-Wonago road near *Chichiu Gebriel* which is located about 5km from town centre. Dilla town is the administrative capital of Gedeo Zone. Dilla is also considered as a commercial town and is especially known for its coffee trade. Based on the 2007 census of Ethiopia, the current projected population of the town is 86,000 with a growth rate of 4.9% per annum. The main highway that connects Ethiopia to Kenya crosses the town. Apart from this highway, there are good road networks in the town.

CURRENT WASTE MANAGEMENT OF DILLA TOWN

SOLID WASTE MANAGEMENT

Generation, Collection and Transportation

Solid waste management in Dilla town is very much limited to bulk collection and disposal. The total annual solid waste generation of the town is estimated to be approximately 3,500 tonnes. About 40-50% of the solid waste produced by the city is collected and disposed of at the dumping site located at *Chito* about 8km away from the centre of the town. Therefore dumping of wastes in the rivers, drainage canals, and open burning are common practices by many inhabitants. According to the recently conducted rapid Assessment of the Solid Waste Management System of Dilla town, the daily waste generation rates from different sources are estimated as: for Households 0.2kg/person, for Commercials 0.4kg/shops, and for hotels/restaurants 1kg/hotel (Cheffo *et al*., 2015).

There are six SMEs primary door to door waste collection service providers which collects household and institutional wastes by using donkey-pull carts. Only about 30% of the population receives the waste collection services. There are 60 waste containers in the town (20 of them with capacity of $8m^3$ and the remaining 40 each have a capacity of $5m^3$). Waste from different sources are collected by SMEs and transferred to temporary transfer stations (containers). The Dilla town municipality is responsible for the collection and disposal of solid waste from the transfer sites (containers) to the open dumping site. The municipality uses one skip loader, three trucks and two tractors (one is currently not operational) for the transportation of waste from these sites to the solid waste dumping site (Cheffo *et al*., 2015).

Waste Disposal

The waste dumpsite, approximately 2ha in extent, is located 8 km away from the town centre at *Chito* site. According to the Dilla structural plan proposal report (ECSA, 2012) indicates that the disposal site is not located in an appropriate areas with respect to the prevailing wind conditions. The structural plan recommends that the disposal site be relocated to an appropriate location. There is no formal waste treatment facility or management practice at the dumpsite, however there are some informal individuals (scavengers) who pick valuable items such as metals, glasses and plastics for reuse or recycling purposes. Some organic leaves from market places are also collected for animal feed.

Associated Solid Waste Management Plan

The municipality has no integrated solid waste management plan or strategy. It has a plan to construct a new standardised landfill at *Waleme* site, located in the north western part of the city. An Environmental Impact Assessment of this proposed landfill site was conducted in 2010. However the landfill construction has not been yet commenced. In addition, the municipality has an annual plan to conduct awareness raising of the community of solid waste management in the 2017/2018 fiscal year.

LIQUID WASTE MANAGEMENT

Liquid waste management (both greywater and faecal sludge) of Dilla town is very poor. Despite the presence of drainage lines for greywater along main roadsides, they are not well managed. Some households and commercial institutions directly connected their domestic liquid wastes to the drainage lines and the drainage lines are serving as an open sewerage line. It was also reported that blockage of drainage ditches by the solid wastes (especially leftover 'chat' and plastic bottle wastes) has been one of the major causes of flooding in the city. This has incurred much expense to the municipality not only to maintaining the drainage system but also on emergency measures whenever flooding occurs.

Currently there are two private and one University owned vacuum trucks for suction of faecal sludge. The faecal sludge is disposed of on the dumping site near the solid waste dumping site without any form of treatment.

The municipality has no strategic or master plan for liquid waste management. However, it has planned to purchase a vacuum truck and create awareness amongst the people how to handle waste in the 2017/18 fiscal year.

8.15 VISUAL

8.15.1 YIRGA ALEM IAIP

The site is located in a rural area surrounded by agricultural land, mixed vegetation and low density settlements. All the buildings established on the site are single storey and predominantly constructed of wood and mud with thatch or corrugated iron roofing. Large areas of the site consist of open grassland with sections of farmland and plantations within the site and agricultural or mixed vegetation surrounding the site.

LANDSCAPE CHARACTER

Most of the Yirga Alem areas are characterised by undulating plateaus and Yirga Alem IAIP constitutes the plain and glade part of the landscape. The site is bordered by river valleys and hilly escarpments in the western and eastern directions, respectively. To the west and south the terrain falls to the Gidabo River valleys at the river bed. The site comprises fairly even land with significant undulations at some portions where large erosion gulleys are evident. These gulleys remain outside the IAIP site boundary.

The Yirga Alem IAIP site consists of large open grassland areas, utilised predominantly for grazing with isolated areas ploughed for crop production, as well as plantations of (non-indigenous) *Eucalyptus* and other crops interspaced with areas of mixed vegetation. **Figure 8-43** provides photographs showing the typical land cover of the IAIP site. The site is considered highly disturbed due to the agricultural activities taking place. There are no designated or registered landscapes within the project area.

March 2017 dry season - (Belg)

August 2017 - rainy season (Kiremt)

View of the site showing grassland and disturbed woodland.

View of the site showing grassland and disturbed woodland.

View of the site showing the predominance of grassland

View of the site showing the predominance of grassland

View of the site showing Eucalyptus plantations.

View of the site showing Eucalyptus plantations.

Figure 8-43: Photographs showing typical land cover of the project area in the dry and wet seasons

Visually the open veld/grass areas are a dull yellow/ brown in colour in the winter (greener in summer) and are of little visual significance. The E*ucalyptus* trees are alien but attractive and provide height and shade. Visually the existing electrical infrastructure in the project area differs from the residential and farming activities in layout and scale. The small residential huts and the low lying pastureland and wetland depressions are much smaller and of lower scale than the transmission line.

Most of the buildings are small residential huts with the exception of the churches, the school and the health centre. There are four churches and a formal gravesite located on the site that represent historical value, however these are not being considered sufficiently significant to be retained (refer to Section 8.17.2 - Cultural Heritage).

The newly erected high tension transmission line (**Figure 8-44**) is the most visually obtrusive structure in the area as it is evident from almost all portions of the site. The establishment of large industrial facilities on the site will result in changes to the existing 'sense of place'. Consultation with the community throughout the ESIA stages has identified that in the context of the development level of Ethiopia, visual impacts arising from such mega projects are considered by the local community receptors to be positive in general. This is because the IAIP/RTC structures adds up to the overall modernization and development of the towns.

Figure 8-44: New overhead power line structure on site

The site is surrounded by very low density residential and farmland areas and dense shrubland, with dwellings being dispersed amidst the mixed farmland, which include Eucalyptus plantations, and dense shrubland areas.

The landscape of the site can be described as relatively flat with some undulations sloping in an outward direction from the centre of the site. The area to the west of the site continues to slope gently downhill into the valley in which the Gidabo River flows. The average width of the Gidabo River is approximately 10-15 m and the height of the banks reach approximately 100 m in height in areas. Therefore visibility of the site is limited from the west.

To the east of the site the landscape slopes gently eastward to a drainage line that runs in a north-south direction parallel to the site. The area then slopes upwards to a ridge line approximately 300m eastwards of the site. The ridgeline is rises above the level of the site in certain places making the site visible from certain areas from the east. There are limited dwellings on the ridgeline and majority of the area consists of *Eucalyptus* plantations and dense shrubland, further limiting the visibility of the site.

To the north and south of the site the areas slope gently away from the site. The site is also bordered to the north, east and south with Eucalyptus plantations and dense shrubland. **Figure 8-45** provides photographs depicting the landscape features of the area surrounding the site.

Looking to the North from the Yirga Alem IAIP

Looking to the South from the Yirga Alem IAIP

Looking to the West from the Yirga Alem IAIP

Looking to the East from the Yirga Alem IAIP

Figure 8-45: Photographs depicting the landscape features in the study area

A low ridge line runs along the length of the eastern side of the IAIP site, peaking approximately 300m east of the site boundary, providing topographic interest. The colours of the land are soft greens, browns and lush greens in the wetland areas, in the wet season and soft browns and greens in the dry season, which contrast with the high blue skies. The site is surrounded to the north, east and south by tree plantations and dense shrubland, shirting the site from view predominantly form the north and south due to the low topographic gradient in these areas. The central portions of the site include clusters of dense shrubland and tree plantations which further break the skyline and present visibility of sections of the site from the open grassland areas.

The current land-use in the area does not significantly alter the natural visual character and the study area is sparsely populated. The patterns created by the agricultural activities, with few dwellings or other man-made structures add to the sense of openness and rural character of the site.

This character is likely to change with the expansion of the Aposto and Yirga Alem towns. The low level warehouse structures and associated horizontal infrastructure will create a more modern character which may positively dominate the immediate visual landscape, adding to the level of development of the area.

ZONE OF INFLUENCE

The distance of a viewer from an object is an important determinant of the visibility, sometimes referred to as the visual exposure. This is due to the visual impact of an object diminishing/attenuating as the distance between the viewer and the object increases. The Zone of Visual Influence (ZVI) is

the maximum extent around an object, beyond which the visual impact will be insignificant, primarily due to distance.

According to Hull and Bishop (1988) the visual impact can be said to decrease at an exponential rate and so at 1000m would, nominally, be 25% of the impact as viewed from 500m. At 2000m it would be 10% of the impact at 500m. More recent studies on viewing distance have built on these early estimations and all emphasise the role that elevation, the angle of the sun and landscape characteristics play in determining visibility over distance.

Given the low elevation of the proposed site, the maximum height prescribed for the proposed development and the undulating nature of the surrounding landscape, the suggested limit of assessment appropriate for this study area is defined as follows:

- less than 1,5km – proposed development is likely to be a prominent feature, dominating perception;
- between 1,5km and 3km – proposed development may be visible and dominate perception to some extent; and
- between 3km and 6km – proposed development may be marginally visible, but other objects would generally dominate perception.
- beyond 6km the proposed development will not be visually dominant and will only be visible from elevated viewpoints.

Potential viewers (visual receptors) included in this study are:

- **Residents in the surrounding areas:** Residents in the surrounding areas may be affected by the visual impacts of the proposed redevelopment and have shown an active interest in the site. However visibility will be very limited from most residential areas, as the site is obscured by vegetation or changes in topography.
- **Motorists:** The current site is not discernable to motorists from the surrounding area. With the development of the IAIP on the site it is possible the site will become more visible to motorists, however the site is not visible from the main road connecting Aposto and Dilla.

8.15.2 DILLA RTC

The RTC site consists of partially transformed land with a small section of the site providing pastureland and the remainder is under plantation. There is a single house and hut located within the project area, a pump house, a high tension line and plantations of coffee, banana, pineapple and Eucalyptus, see **Figure 8-46**. The site has a uniform topography located on the lower slope of a small hill limiting the visibility of the site to one or two directions.

Figure 8-46: Images showing the site including the (A) pump station and hill, (B) surrounding hills, and (C) the plantation zone (Source: ESIA Team Site Investigations)

The key landscape character of this site is the visual barrier the hill will offer to the RTC restricting its visibility to the inhabitants and visitors of Dilla.

8.16 BIODIVERSITY

This section provides a description of the existing biodiversity components and associated key features which include typical flora and fauna, protected areas and non-protected sensitive resources that are found inside and within the vicinity of the project sites. The baseline conditions within the survey area have been determined through desk-based reviews of available information, field investigations and consultations with concerned authorities.

8.16.1 YIRGA ALEM IAIP SITE

FLORA

The Yirga Alem IAIP site consists of large open grassland areas, utilised predominantly for grazing with isolated areas ploughed for crop production, as well as plantations of (non-indigenous) *Eucalyptus* and other crops interspaced with areas of mixed vegetation. The site is considered highly disturbed due to the agricultural activities taking place.

The Yirga Alem and Aposto area in general, and the IAIP site in particular, are located within the Somalia-Masai Acacia-Commiphora deciduous bushland and thicket system (**Figure 8-47**).

Previous assessments show that the land cover of most of the western part of Yirga Alem Area falls into the moderately cultivated category (**Figure 8-48**).

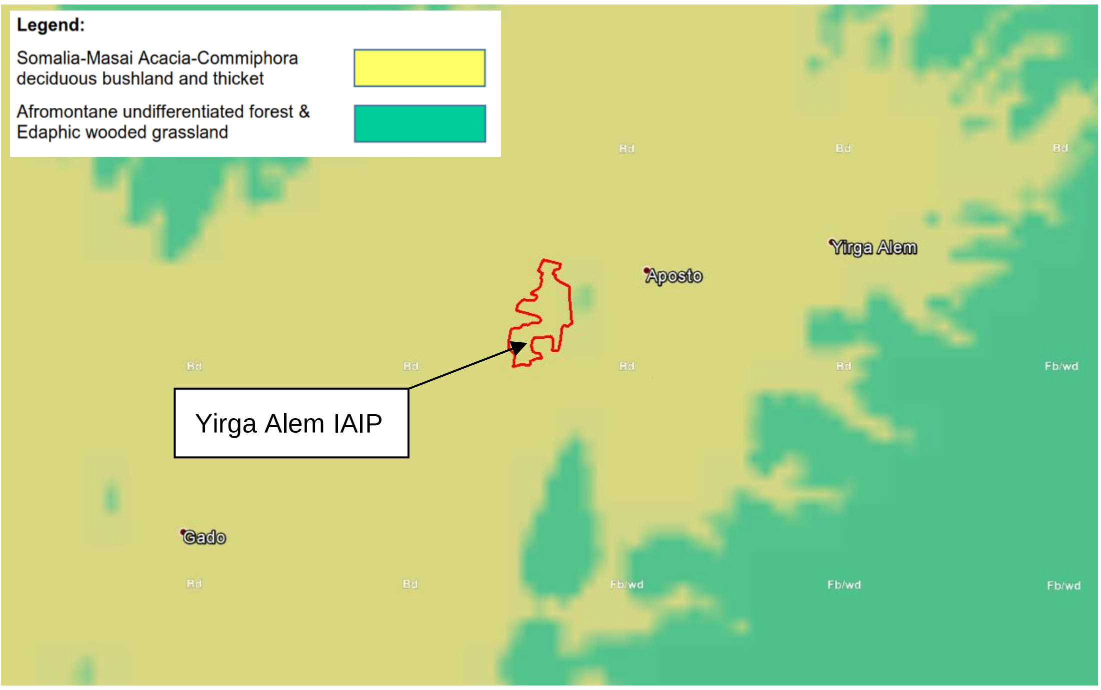

Figure 8-47: Layout showing vegetation systems in the area of the IAIP site (Source: Kindt, et al., 2015 & van Breugel, et al., 2015)

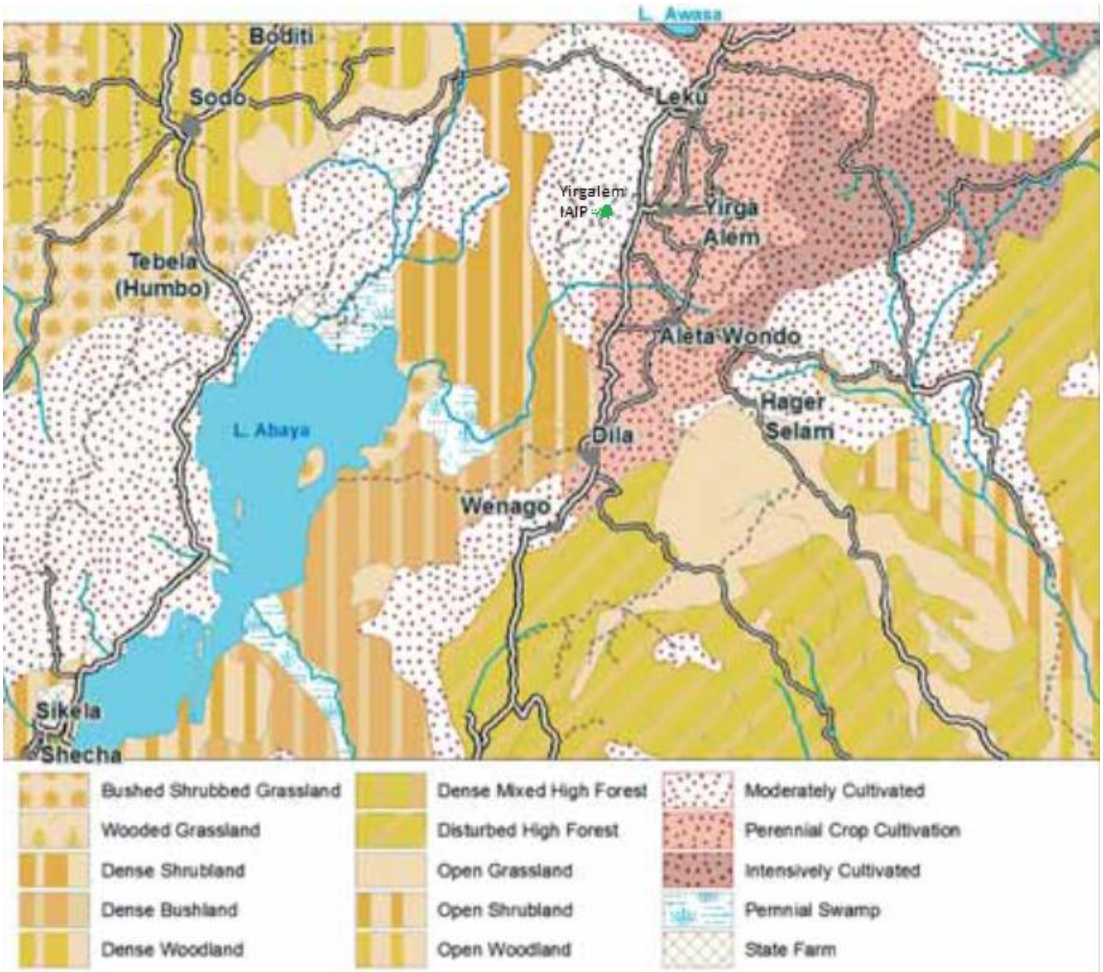

Figure 8-48: Land Cover of Yirga Alem and Dilla Areas (source: Habtamu & Rapprick, 2014)

The Yirga Alem IAIP project site area comprises transformed woodland and open grassland. The woodland is largely dominated by *Eucalyptus spp*. surrounded by *Ficus sycomorus, Cordia Africaan, Croton macrostachys*, and *Euphorbia candelabrum* with the undergrowth of Coffee *arabica* and *venonia amygdalina* and *Ananas comosus*. *Aloe vera*, *Agave sisalana* and *Euphorbia tirucalli* are also planted along the degraded areas and edge of abandoned cultivation areas to prevent erosion and mark the boundary of plots. In some patchy areas, *Podocarpus falcatus* and *Millettia ferruginea* also occurs. The dominant grass species include *Cynodon dactylon, Hyparrhenia rufa* and *Chrysopogon spp*.. **Figure 8-49** provides photographs of the site indicating typical land cover of the project area.

Based on the site investigations conducted, a total of 20 plant species were recorded (**Table 8-36**). All of the species identified on the site are not threatened (according IUCN Red List Category), however over half of them, with exception to grasses, are included in the list of '*useful trees and shrubs of Ethiopia*' as they are considered very important for various purposes.

Table 8-36: List of Common Plant Species recorded at Yirga Alem IAIP

No.	Species Scientific Name	Amharic Name	Conservation Status (IUCN Red List Category)	Usefulness Category List*
1	Eucalyptus grandis	Key Bahirzaf	LC	L
2	Ficus sycomorus	Warka	LC	L
3	*Ficus vasta*	Warka	LC	L
4	*Cordia Africana*	Wanza	LC	L
5	*Erythrina brucei*	Korch	LC	L
6	*Croton macrostachys*	Bisana	LC	L
7	*Podocarpus falcatus*	Zigba	LC	L
8	*Millettia ferruginea*	Birbira	LC	L
9	*Euphorbia candelabrum*	Kulkual	LC	NL
10	*Euphorbia tirucalli*	Kinchib	LC	L
11	*Aloe vera*	Eret	LC	L
12	*Agave sisalana*	Katcha	LC	NL
13	*Vernonia amygdalina*	Grawa	LC	L
14	*Coffea arabica*	Buna	-	Cash crop
15	*Ananas comosus*	Ananas	-	Cash crop
16	*Musa paradisiaca*	Muz	-	Cash crop
17	*Cynodon dactylon*	Sar	-	Grass Spp.
18	*Hyparrhenia rufa*	Sar	-	Grass Spp
19	*Sporobolus spp.*	Sar	-	Grass Spp
20	*Chrysopogon spp.*	Sar (Senbelet)	-	Grass Spp

***According to Azene Bekele (2007) categorization of 'Useful Trees and Shrubs of Ethiopia'; where L= Listed; NL= Not Listed

Figure 8-49: Photographs showing typical land cover of the project area

FAUNA

According to the data gathered by the Woreda Environmental Protection and Forestry Development Office, the Yirga Alem IAIP provides habitats and it is a potential home range for about eight species of larger mammals of wild animals (**Table 8-37**). The dominant bird species in the project area are Silvery-cheeked Hornbill (*Bycanistes brevis*), Egyptian Goose (*Alopochen aegyptiacus*), Fan-tailed Raven (*Corvus rhipidurus*), Village Weaver (*Ploceus cucullatus*) and various species of raptors. During the field observation, a total of 21 species were recorded (refer to Annex.1 of the Biodiversity Assessment Report attached as **Appendix C-11**).

Table 8-37: List of Wild Mammal Species of the Project Site (source: Dale Woreda Environmental Protection and Forestry Development Office (2016) and Field survey (2017).

No.	Species Common Name	Scientific Name	Conservation Status (IUCN Red List Category)
1	Vervet Monkey	*Cercopithecus aethiops pygerythrus*	LC
2	Grey Duiker	*Sylvicapra grimmia*	LC
3	Common Bushbuck	*Tragelaphus scriptus*	LC
4	Spotted Hyena	*Crocuta crocuta*	LC
5	African Civet	*Civettictis civetta*	LC
6	Abyssinian Hare	*Lepus habessinicus*	LC
7	Porcupine	*Hystrix cristata*	LC
8	Anubis Baboon	*Papio Anubis*	LC

In addition, like other parts of rural areas of the region, cattle (ox, cow) and equids (mammal of the horse family) are the predominant domestic animals observed in the area.

Generally, the indigenous trees found on site are used as nesting, feeding, breeding and roosting habitats for some birds which play key role in maintaining the micro and micro ecosystem integrity. Specifically, the project site provides habitat for a considerable number of avian species that require

special consideration as a result of their protection under various conservation efforts. According to IUCN Red List Category, about three species of vultures (White-backed, Ruppell's and Hooded Vultures), which were observed flying over the site are critically endangered or endangered.

PROTECTED AREAS

The area set aside for the Yirga Alem IAIP development does not lay within a designated conservation area and there are no protected areas in the vicinity. The designated forest area in the vicinity of the site which covers about 520 ha comprises of exclusive man-made *Eucalyptus* plantation and thus it is not a site of conservation concern. The forested areas, in the vicinity of the site, are characterised by *Ficus sycomorus, Ficus vasta, Erythrina brucei* and *Maesa lanceolata* with undergrowth of *Arundo donax, Vernonia amygdalina* and *Cyprus* and *Typha* species. Even though no water birds count was conducted along this particular area, some water birds such as Egyptian Goose (*Alopochen aegyptiacus*), Hamerkop (*Scopus umbretta*), Sacred Ibis (*Threskiornis aethiopicus*) and Grey Heron (*Ardea melanocephala*) were reported to inhabit in the area (Adugna and Bogale, 2015).

BIODIVERSITY SENSITIVITY

The woodland is largely dominated by Eucalyptus spp. surrounded by *Ficus sycomorus, Cordia Africana, Croton macrostachys, and Euphorbia candelabrum*. These trees and undergrowth vegetation cover support a wide variety of faunal species especially birds and are ecologically important. Additionally vegetation has been planted along degraded areas and edge of abandoned cultivation areas to prevent erosion.

Based on mapping of the biodiversity sensitivity of the proposed site, the Yirga Alem IAIP site is defined as containing very high, high, medium and medium low sensitivity environments (**Figure 8-50**).

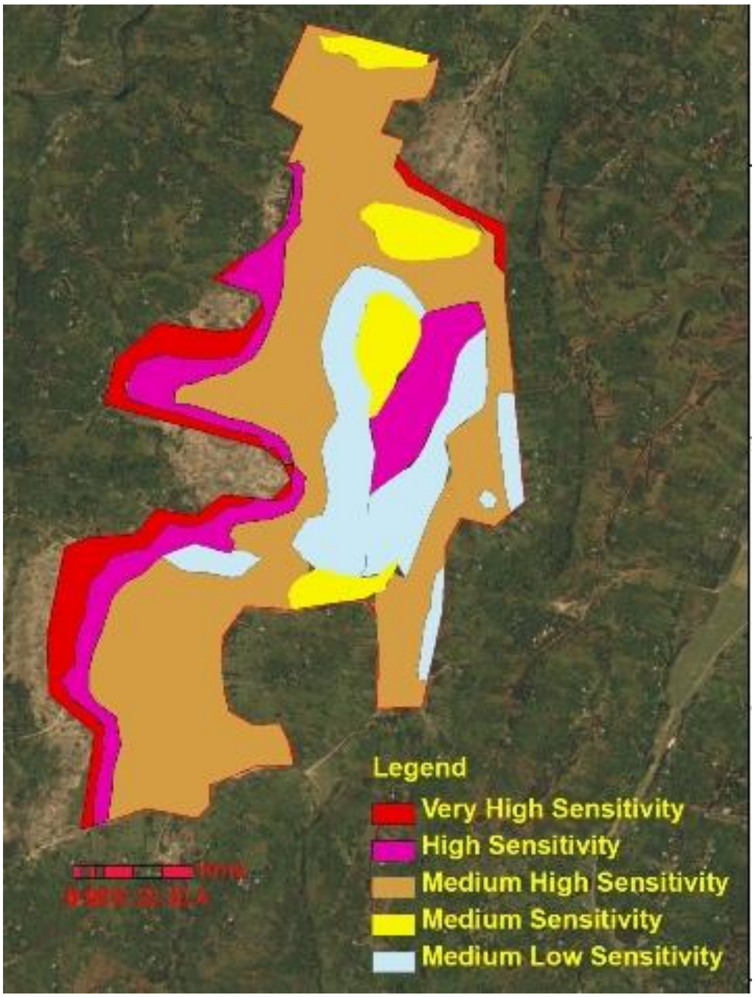

Figure 8-50: Biodiversity sensitivity map of Yirga-Alem IAIP site

8.16.2 DILLA RTC

FLORA

The Dilla RTC site is 9.88 ha in extent. The site consists of a large open grassland area of approximately 2.6 hectares in area, the remainder of the site consists of sections of plantations (*Eucalyptus*) as well as a large vegetated area consisting of mixed integrated farmland interspersed with small portions of natural vegetation. This diversity in vegetation is shown in **Figure 8-51**. The vegetated area comprises crops grown at varying levels which include pineapples, coffee, bananas, mangos, avocadoes.

A total of 26 species of plants have been recorded in the specific project site of Dilla RTC (**Table 8-38**). The site is characterised by open grassland and multilayer agro-forestry habitat. This site is named after *Chrysopogon spp.* (Senbelet) which is dominated by the same grass species as well as *Pennisetum spp*., *Cynodon dactylon* and *Hyparrhenia rufa*. The native woody species occupying the upper layer of the agro-forestry habitat include *Ficus sycomorus*, *Ficus sur*, *Cordia Africana*, *Croton macrostachys* and *Erythrina brucei*. The middle layer is mainly constituted *by Coffea arabica, Ensete ventricosum, Prunus persica, Musa spp.* and *Vernonia amygdalina*.

Table 8-38: Checklists of common plant species of Dilla RTS

No.	Species Scientific Name	Amharic Name	Conservation Status (IUCN Red List Category)	Usefulness Category List*
1	*Ficus sycomorus*	Warka	LC	L
2	*Ficus sur*	Warka	LC	L
3	*Cordia Africana*	Wanza	LC	L
4	*Erythrina brucei*	Korch	LC	L
5	*Croton macrostachys*	Bisana	LC	L
6	*Podocarpus falcatus*	Zigba	LC	L
7	*Millettia ferruginea*	Birbira	LC	L
8	*Eucalyptus spp.*	Key Bahirzaf	LC	L
9	*Euphorbia candelabrum*	Kulkual	LC	NL
10	*Vernonia amygdalina*	Grawa	LC	L
11	*Strychnos spinosa*	Dokma	LC	L
12	*Arundo donax*	Shembeko	LC	L
13	*Otostegia integrifolia*	Tunjit	LC	L
14	*Coffea arabica*	Buna	-	Cash crop
15	*Ananas comosus*	Ananas	-	Cash crop
16	*Musa paradisiaca*	Muz	-	Cash crop
17	*Persica spp.*	Avecado	-	Cash crop
18	*Ensete ventricosum*	Enset	LC	L
19	*Psidium guajava*	Zeituna	LC	L
20	*Prunus persica*	Kock	LC	L
21	*Mangifera indica*	Mango	LC	L

No.	Species Scientific Name	Amharic Name	Conservation Status (IUCN Red List Category)	Usefulness Category List*
22	*Cynodon dactylon*	Sar	-	Grass Spp.
23	*Chrysopogon spp.*	Sar (Senbelet)	-	Grass Spp.
24	*Hyparrhenia rufa*	Sar	-	Grass Spp.
25	*Sporobolus spp.*	Sar	-	Grass Spp.
26	*Pennisetum spp.*	Sar	-	Grass Spp.

***According to Azene Bekele (2007) categorization of 'Useful Trees and Shrubs of Ethiopia'; where L= Listed; NL= Not Listed

Figure 8-51: A typical Agro-forestry Habitat and Vegetation Layers and Open Grassland at the RTC site

FAUNA

According to the Woreda Environmental Protection and Forestry Development Office, the Dilla RTC project site and its immediate adjacent areas provide a habitat for about 9 species of larger mammals of wild animals (**Table 8-39**). Cattle (ox, cow) and donkeys are among the predominantly domestic mammals owned by local community.

Table 8-39: List of Wild Mammal Species of the Project Site (Dilla RTC)

No.	Species Common Name	Scientific Name	Conservation Status (IUCN Red List Category)
1	Vervet Monkey	*Cercopithecus aethiops pygerythrus*	LC
2	Guereza	*Colobus guereza*	LC
3	Grey Duiker	*Sylvicapra grimmia*	LC
4	Common Bushbuck	*Tragelaphus scriptus*	LC
5	Spotted Hyena	*Crocuta crocuta*	LC
6	African Civet	*Civettictis civetta*	LC
7	Common Jackal	*Canis aureus*	LC
8	Abyssinian Hare	*Lepus habessinicus*	LC
9	Porcupine	*Hystrix cristata*	LC

Source: Dilla Zuria Woreda Environmental Protection and Forestry Development Office (2016) and Field survey (2017).

During the survey, 31 bird species were recorded in the site and its adjacent areas (refer to Annex.2 of the Biodiversity Assessment Report attached as **Appendix C-11**). The dominant bird species in project area are Silvery-cheeked Hornbill (*Bycanistes brevis*), Egyptian Goose (*Alopochen aegyptiacus*), Wattled Ibis (*Bostrychia carunculata*), Thick-billed Raven (*Corvus crassirostris),* Hooded Vulture (*Necrosyrtes monachus*) and Abyssinian Slaty Flycatcher (*Melaenornis chocolatinus).*

Figure 8-52: Some of the Commonly Observed Birds (Wattled Ibis, Abyssinian Slaty Flycatcher and Hooded Vulture) at Dilla RTC

Among the avian species observed at the proposed Dilla RTC about 4 species of birds (all vultures) are critically endangered or endangered and one species (Bateleur) is near threatened though they are found abundantly throughout Ethiopia. Moreover, Wattled Ibis (*Bostrychia carunculata*) and Thick-billed Raven (*Corvus crassirostris*) are considered as near endemic since they are only found in limited range of Ethiopia and Eritrea (**Table 8-40**).

Table 8-40: List of Threatened Bird Species of the Project Site

No	Species Common Name	Scientific Name	Conservation Status (IUCN Red List Category)
1	White-backed Vulture	*Gyps africanus*	CEN
2	Ruppell's Vulture	*Gyps rueppellii*	CEN

No	Species Common Name	Scientific Name	Conservation Status (IUCN Red List Category)
3	White-headed Vulture	*Trigonoceps occipitalis*	EN
4	Hooded Vulture	*Necrosyrtes monachus*	EN
5	Wattled Ibis	*Bostrychia carunculata*	LC/NE
6	Thick-billed Raven	*Corvus crassirostris*	LC/NE

Where, EN – Endangered; CEN – Critically Endangered; LC/NE – Least Concern but Near Endemic

PROTECTED AREAS

There is no designated conservation area in the vicinity of Dilla RTC. There are however some wetlands that include rivers and surrounding swamp areas. There are two rivers; namely Legedarra at the North and Chichiu at the South of Dilla town which are flowing east and west down to Lake Abaya. Chichiu river is situated at immediate adjacent to the project site. The vegetation of the riverine areas characterized by *Ficus spp., Maesa lanceolata, Arundo donax, Vernonia amygdalina* and *Cyprus* and *Typha* species. *Prunus africana* which is part of the gallery forest is vulnerable according to IUCN red listing.

BIODIVERSITY SENSITIVITY

The native woody species occupying the upper layer of the agro-forestry is dominated by Ficus and Croton species. These trees and the middle layer vegetation cover provide habitats for considerable number of species of mammals and birds and are considered to be ecologically important.

Based on mapping of the biodiversity sensitivity of the proposed site, the Dilla RTC site is defined as containing high, high, medium and medium low sensitivity environments (**Figure 8-53**).

Figure 8-53: Biodiversity sensitivity map of Yirga Alem IAIP site

8.17 SOCIO-ECONOMIC ENVIRONMENT

8.17.1 GENERAL

The purpose of this section is to describe the socioeconomic environment within which the Project is located. The description provided in this section is based on publically available high level secondary data and primary data collected for the Project area during the ESIA process.

The proposed Yirga Alem IAIP and Dilla RTC sites are located in the Eastern SNNP Region, with the IAIP located in the Sidama zone and the RTC located in the Gedeo zone. Hawassa is the capital of the Sidama zone and is located approximately 220 km South-West of Addis Ababa, the country's capital city. Dilla is the capital of the Gedeo zone and is located approximately 356 km south of Addis Ababa.

The IAIP footprint in Sidama will occupy approximately 214.86 hectares (ha[6]). After this project was taken forward, in early 2016, the Government initiated the resettlement process and to-date completed a survey of project affected people. In early September 2017 the Government also started contacting affected people to organise payment of compensation. The RTC footprint in the Gedeo Zone will occupy approximately 9.88 ha. The Government also has started the relocation process at the RTC site, and the survey of affected people was completed two years ago

Based on the census data collected by the IPDC, the proposed SNNP Project (including the IAIP and RTC facilities) will result in 229 PAPs being affected by a combination of economic and physical displacement, 176 PAPs being economically displaced, 18 PAPs being physically displaced, and 44 PAPs being affected where their familial graves will need to be moved, resulting in a total 467 PAPs. Taking into account that the average number of people in a typical SNNP region household is 4.8 (World Bank, 2015), there is the potential that over 2,000 people could be affected by the land use changes and displacement caused by the project.

The Area of Influence (AoI) can be defined as the area likely to be affected by the proposed Project activities during the pre-construction, construction, operations and closure / decommissioning phases. Given the nature of the Project and its anticipated impacts, the Project AoI for socio-economic aspects and the associated baseline description covers:

- The area likely to be affected by the proposed Project activities during the pre-construction, construction, operations and closure / decommissioning phases;
- The IAIP and RTC areas from where the affected households will be relocated by the Government;
- The area occupied by the IAIP's and RTC's auxiliary infrastructure, including the access road and construction camp; and
- New locations where the affected households will be moved to.

8.17.2 BASELINE ENVIRONMENT

ADMINISTRATIVE AND DEMOGRAPHIC ENVIRONMENT

The IAIP site is located within the SNNP Region, which is further divided into 13 administrative zones which are then further sub-divided into 133 Woreda governments and urban administrations, all of which, under Ethiopia's decentralised system of government, have their own governing councils.

[6] As per the final MACE designs Master Plan layout dated 10/4/2017 and final drawings released for construction use.

The SNNP region is a large region in Ethiopia, accounting for more than 10% of the country's surface area. The population is estimated at nearly 18 million; amounting to around a fifth of the country's population (Central Statistical Agency, 2015). It is overwhelmingly rural, with only 8% living in urban areas. The SNNP Region has a population density of 136 persons per 1 km2, and the population is growing at 2.9% per annum (Bureau of Finance and Economic Development, 2014).

On the town level, the proposed Yirga Alem IAIP site falls under the jurisdiction of Hawassa Town within the Sidama administrative zone. The Sidama Zone is spread between northeast of Lake Abaya and southeast of Lake Hawasa, and covers 21 Woredas. The Sidama Zone is bordered by the Arsi Oromo in the north and west, Gedeo, Burji, Guji Oromo people groups in the south, Guji Oromo in the west, and Wolayta and Kambata language groups to the east.

Important cities and towns in the SNNP region include: Wolkite, Hisaina, Durame, Hawassa, Dilla, Sodo, Jinka, Masha, Bonga, Arbaminch, Mizan Aman, Tercha, Halaba, Fofa, Segen, Laska and Ameya. Hawassa is the capital of the region.

Based on the latest population estimates (CSA, 2015) the entire region has 3,110,995 households, which results in an average of 4.8 persons to a household (data for the SNNP region), with urban households having on average 3.9 and rural households 4.9 people.

Using the 2015 CSA estimates, nearly 40% of the Region's population is made up by children (0-14 year olds). Nearly 23% of the region's population is represented by young people (15-29 year olds), 19% by people between 30 and 60 years of age, and the rest are over 60.

Based on the latest population estimates (CSA, 2016), the Sidama Zone has a total population of 2,954,136 people, of which 1,491,248 are men (50.5%) and 1,462,888 women (49.5%); and occupies an area of 6,538.17 km2. Sidama has a population density of 451 people per 1 km^2. A total of 592,539 households were recorded in this Zone, which results in an average of 4.99 persons to a household.

In comparison, the latest population estimates (CSA, 2016) show that the Gedeo Zone has a total population of 847,434 people, of which 424,742 are men (50.1%) and 422,692 are women (49.9%); with an area of 1,210.89 km^2. Gedeo has a population density of 699.84 per 1km^2. A total of 179,677 households were counted in this Zone, which results in an average of 4.72 persons to a household. The CSA of Ethiopia estimated (2013) that the overall population of the Gedeo Zone will reach 1,109,454 people by 2017 (CSA, 2013b)

MIGRATION PATTERNS

Ethiopia is experiencing strong economic growth and migration trends. The reports of the Ministry of Labour and Social Affairs (MoLSA) registered 460,000 legal migrants between September 2008 and August 2013, the majority of whom obtained overseas jobs as domestic workers. 79% of such people were travelling to Saudi Arabia, 20% to Kuwait and the rest to Dubai and other countries.

One of the major reasons for such significant migration is believed to be the shortage of land that can be made available to the youth and young families. Only vacant land whose owners are deceased is usually transferred to the youth on the basis of age of the applicants. However, the amount of such land being available for internal re-distribution among community members is limited.

Local communities are witnessing the changes brought by such migration, where the improved well-being in the families with migrant' members are pushing other families to take the same decision and send one of their members to work overseas.

LAND TENURE AND LAND USE

In Ethiopia all land belongs to the State; whilst land can be leased to private individuals, they cannot own it. The Constitution provides for equal access, use, transfer and administration over land. It grants access to agricultural land for rural residents, and allows all inhabitants to utilise the land for farming. Farmers and pastoralists could be granted lifetime 'holding rights' giving them rights to farm the land except for its sale and mortgage. The land holdings in the Region are generally very small and usually the average amount of land is less than one hectare per household.

In the SNNP region, land usage certificates that belong to married couples typically record both the name of the husband and wife, giving equal rights to the wife. However, this depends on communities,

as some local communities practice polygamy in the SNNP Region, and in such families the names of the husband and his first wife are often recorded in the land certificate (USAID, 2013).

There are two predominant soil types that are present in the region. The first, found in areas with relatively good drainage, consists of red-to-reddish-brown clayey loams that hold moisture and are well endowed with needed minerals, with the exception of phosphorus. These types of soils are found in much of the SNNP Region. The second type consists of brownish-to-gray and black soils with a high clay content. These soils are found in both the northern and the southern highlands in areas with poor drainage (Thomas *et* al, 1991).

The Region is rich in water resources, but the resources are not used to their full potential. Morbidity and mortality in SNNP region are often attributable to lack of clean drinking water, poor sanitation, and low public awareness of environmental health and personal hygiene practices.

The Sidama zone is the leading coffee producing zone in Ethiopia, which significantly contributes to the foreign exchange of the federal government. The Central Statistical Agency (CSA) reported that 63,562 tons of coffee was produced in Sidama and Gedeo combined in the year ending in 2015, based on the Ethiopian Coffee and Tea authority records. This represents 63% of the SNNP's overall coffee production output and 28% of Ethiopia's total output.

Other main crops grown in the region include: maize, teff, Enset (false banana), coffee, potato, wheat, fruits and vegetables. Enset (*Ensete ventricosum*) is a widely produced staple food in the region.

The Gedeo Zone, similar to the Sidama Zone, is famous for its coffee production. Although Gedeo is a leading coffee producer in the area, the farmers themselves do not always profit from this commodity mainly due to lack of financial planning skills and dependence on the weather.

The Gedeo area also experiences economic benefits associated with the natural beauty of the landscapes in the area including the well-kept agroforest and agricultural systems. The Gedeo agroforestry system, by its nature, is home to a diversity of flora and fauna which provides a further boost to tourism (Koofhafkan and Miguel, 2016).

ETHNICITY, RELIGION AND LANGUAGES

The three largest ethnic groups reported to be residing in the Sidama Zone, include: the Sidama (93.01%), the Oromo (2.53%), and the Amhara (1.91%). Sidamo is spoken as a first language by 94.23% of the inhabitants, 2.14% speak Amharic, and 2.07% Oromiffa; the remaining 1.56% spoke all other primary languages reported.

Approximately 84.38% of the population are Protestants, 4.62% Muslim, 3.35% practiced Ethiopian Orthodox Christianity, 3.01% embraced Catholicism, and 2.72% observed traditional religions (CSA, 2015).

The four largest ethnic groups reported in the Gedeo Zone are: the Gedeo (86.14%), the Oromo (4.71%), the Amhara (3.37%) and the Gurage (1.55%); all other ethnic groups made up 4.23% of the population.

Gedeo is spoken as a first language by 86.82%, 5.82% speak Amharic and 4.12% speak Oromiffa; the remaining 3.24% spoke all other primary languages reported.

Over 74% of the inhabitants are Protestants, while 10.67% practice Ethiopian Orthodox Christianity, 7.96% observed traditional religions, 2.44% were Muslim, and 2.11% embraced Catholicism (CSA, 2015).

EDUCATION

At the country level (National Census Data, CSA website), the majority of Ethiopians do not have sufficient education, with females being less educated than males. Based on the latest National Census data, 48% of females and 37% of males have never attended school. 42% females and 48% males have only primary education, while 3% of females and 4% of males completed primary education and did not attend secondary school. Only 5% of females and 6% of males have attended but not completed secondary education, and an additional 3% of females and 5% of males have completed secondary or higher education. In urban areas, 42% of the population are illiterate.

Furthermore, according to a 2013 survey undertaken by the Central Statistical Agency and the World Bank, the literacy level (for reading and writing in any language) reached 53 % for males and only 36 % for females (CSA and WB 2015). About 40 % of boys and 37 % of girls (7-18 years) are not in school and about 60 % are enrolled in primary schools and the remaining few (less than 3 %) are enrolled in secondary school.

Education plays a crucial role in the process of social and economic transformation and stands as a key poverty reduction method. Taking into account the role education plays in the socio-economic development, the Ethiopian government has paid great attention to promoting education in various regions of the country including the study project area. Accordingly, the project area regional bureau has also made various efforts for the development of education in the region to this end, woredas are no exception.

In the Sidama Zone approximately 68% of all eligible children are enrolled in primary school, and 18% in secondary schools. While 65% of all eligible children are enrolled in primary school, and 17% in secondary schools in the Gedeo Zone.

It is noted that Dilla, an administrative centre/capital of the Gedeo Zone, hosts the Dilla College of Teachers' Education, which was founded in 1996 and was part of Debub University. The college became a fully-fledged University in 2007 and offers more than 30 programs to ranging from bachelor's to Masters and degree.

HOUSEHOLD INCOME AND EXPENDITURE

According to data obtained from the Finance and Economic Development Office within the general project areas, the household income level is low in the project area. Accordingly, the figures for low, middle and high level monthly incomes in Ethiopian Birr are respectively: <150, 500-1500, and >1500. Cash income sources are mainly from sales of agricultural products (sales of crops, livestock and their produces), which are the source of more than 80% of the cash income of financially comfortable households in the project area.

The SNNP region has diverse agricultural zones, fertile soil and good water resources, and all this creates a huge potential for production of a variety of agricultural products including crops both for export and domestic consumption, especially coffee.

Though the community gets good income from coffee selling, they become temporarily financially comfortable only for three months during coffee production and selling months and then struggle financially during the remaining nine months, due to poor financial management and weak savings (Finance and Economic Development Office, 2015).

The 2013 survey undertaken by the Central Statistical Agency and the World Bank indicated that fertilizer is a major expenditure source and is used in over half of major food grain fields (CSA and WB 2013). In addition, it identified that cash and food transfers are the most common types of other incomes available to households. Other sources of alternative income are received through a cash transfer from friends and relatives (10%) with an annual average amount of Birr 1,535 (approximately USD 82.00). Households also receive food, cash or other non-food in kind assistance from government and non-government programs.

Of the population, 15.4% in the Sidama zone and 19.6% in the Gedeo zone is in non-farm related jobs, compared to the national average of 25% and a regional average of 32%.

EXISTING INFRASTRUCTURE AND SERVICES

Despite the zone being rich in water sources, much of the SNNP regions morbidity and mortality are often attributable to lack of clean drinking water, poor sanitation, and low public awareness of environmental health and personal hygiene practices (CSA and WB 2013).

According to a Road and Infrastructure Survey carried out by the World Bank in the Sidama Zone in 2014, 8% of the inhabitants of Sidama have access to electricity, this zone has a road density of 137.4 kilometres per 1000 km2 (compared to the national average of 30 kilometres),

Based on the Sidama Zonal Department of Water, Mines and Energy (SZDWM&E) data collected in 2011, the average water access for Sidama Zone is 39%, while for the rural Woredas of the Zone water access stands as about 33% (Note: the percentages quoted include those both functioning and

non-functioning but repairable water systems[7]). The IAIP site falls under line No.2 (Hawassa) where access to water stands close to 27% (**Table 8-41)**.

Table 8-41: Status of Water Supply Coverage in the Sidama Zone

#	Woreda	Rural Population	Number of water supply schemes										Rural popul. served	Access (%)	Popul. not served
			HDWs with hand pump		SW with hand pump		DWs with distribution		Springs with distribution		Spot springs				
			FN	NF	FN	NF	FN	NF	FN	NF	FN	NF			
	SIDAMA RURAL	**3,030,131**	**206**	**39**	**398**	**48**	**67**	**0**	**4**	**0**	**1,206**	**73**	**1,075,891**	**35.51**	**1,954,240**
1	Shebedino	198,928	20	3	43		19				58	3	109,426	55.01	89,502
2	Hawasa Zuria	146,200	12	2			1		1				38,986	26.67	107,214
3	Arbegona	143,758	5				2				80	5	36,706	25.53	107,052
4	Dale	192,533	49	5	66	12	6				84	6	100,524	52.21	92,009
5	Aleta Wondo	174,366	29	8	61	3	1				121		83,449	47.86	90,917
6	Dara	151,877	7	4	3		5				184	8	85,802	56.49	66,075
7	Hula	127,687			22	8	2		1		146		69,759	54.63	57,928
8	Bensa	275,537	5		36		4		1		92	12	62,635	22.73	212,902
9	Aroresa	177,815	11	2	9	3					63		25,108	14.12	152,707
10	Boricha	247,467	6	1	6	2	5						62,746	25.36	184,721
11	Gorchie	146,084									70	9	26,702	18.28	119,382
12	Malga	119,172	27	6	1		1				53		30,594	25.67	88,578
13	Wensho	126,096									34	3	15,622	12.39	110,474
14	Loka Abaya	103,690	7	2	32	5	4						32,591	31.43[25]	71,099
15	Chire	119,573									15		24,773	20.72	94,800
16	Bursa	105,179	3		11	4	1				49	15	32,610	31.00	72,569
17	Chuko	179,409			101	11	14				10	2	101,622	56.64	77,787
18	Bona Zuria	134,564			6		2				113	10	50,942	37.86	83,622
19	Wondogenet	160,196	25	6	1				1		34		85,294	53.24	74,902

Source: SZDWM&E March 2011

Notes: Water access includes only WSSs that were reported by the Woredas as functional in the time of data gathering. FN=functional, NF=not functional.

Notes: HDW – hand dug well with hand pump, SW – shallow well with hand pump, DW – deep well with distribution system.

According to a survey undertaken by the World Bank (World Bank, 2004), 11% of the inhabitants of Gedeo have access to electricity. This zone has a road density of 231.7 kilometres per 1000 km^2 (compared to the national average of 30 kilometres). The average rural household has 0.3 ha of land (compared to the national average of 1.01 ha of land and an average of 0.89 for the SNNP Region) and the equivalent of 0.2 heads of livestock.

19.6% of the Gedeo Zone population is involved in non-farm related jobs, compared to the national average of 25% and a Regional average of 32%.

The following social infrastructure and services were identified on the IAIP and RTC sites during site investigations undertaken by the ESIA team.

YIRGA ALEM IAIP

A school is located in the central section of the proposed site (**Figure 8-54**). Similar to the school, the suitability of locating the healthcare facility within the IAIP is to be assessed in terms of safety to staff and community members utilising the services of the facility.

[7] Water supply schemes in Ethiopia are officially divided in to 3 categories: functional, not functional but repairable, not functional and not repairable. The table's official figures are based on functional + non-functional but repairable unless specified

Figure 8-54: School located on IAIP site (Source: ESIA Team Site Investigation)

A healthcare facility is located in the northern section of the site (**Figure 8-55**). The facility currently provides health care to the residents in the area. It has been indicated that the healthcare facility is to be retained on the site to continue servicing the community.

Figure 8-55: Healthcare facility located on IAIP site (Source: ESIA Team Site Investigation)

Adjacent to the healthcare facility is an agricultural training centre. The existing structures are intended to be demolished and the training centre incorporated into new facilities within the IAIP.

Figure 8-56: Agricultural training facility located on IAIP site (Source: ESIA Team Site Investigation)

Similarly a farmer's cooperative facility is located on the site (**Figure 8-57**). This facility is also to be demolished and a new receiving centre is to be established allowing local farmers to deliver produce directly to the IAIP for sale.

Figure 8-57: Farmers' cooperative facility on the IAIP site (Source: ESIA Team Site Investigation)

A total of 334 households are to be directly affected by the proposed IAIP, requiring relocation and compensation for their dwellings and / or farming activities. **Figure 8-58** shows a sample of dwellings located at the IAIP site.

Figure 8-58: Sample of dwellings located on the site (Source: ESIA Team Site Investigation)

DILLA RTC

Based on the ESIA's team site observations, other than residential dwellings the only infrastructure located in the vicinity of the proposed RTC site includes the existing pump house (**Figure 8-59**) and overhead power line. The overhead power line is planned to be relocated off the site by the Ethiopian Electric Power (EEP) and the existing pump house is to be retained.

Figure 8-59: Pump house facility on the RTC site (Source: ESIA Team Site Investigation)

CULTURAL HERITAGE

YIRGA ALEM IAIP

A number of cultural heritage elements are located within the SNNP Yirga Alem site. The ESIA team identified the following cultural heritage features on the site

- Kalehiwet Church (total floor area of 484 m^2 and side walls constructed out of stone and mud);
- Mesgana Church (constructed out of wood and mud);
- Muluwengel Church (constructed out of wood and mud); and
- Wenaainata Church (constructed out of wood and mud).
- Graves
  - Eight graves are located within the compound of Kalehiwet Church;
  - Several other graves are reported throughout the IAIP area associated with individual dwellings.

Figure 8-60 shows the Kalehiwet Church, including the graves found in church compound area. The churches are constructed using mud and wood with metal sheets for the roof **Figure 8-61**.

Figure 8-60: Photographs showing the Kalehiwet Church (top), and graves within compound of Kalehiwet Church (bottom)

Figure 8-61: Photographs showing the churches on site constructed of wood and mud.

In Ethiopia, the Council Of Ministers Regulation No 135/2007 provides legislation governing the disturbance or relocation of gravesites. Any impacts on the grave site for the purpose of implementation of the Yirga Alem IAIP facility will be governed by the provisions of the Regulation indicated above. However compensation rates are not detailed under this regulation and this issue will be explored and assessed further during the ESIA process.

Consultation undertaken with the community at the Yirga Alem IAIP site identified that the community have no significant concerns with the proposed relocation of these cultural heritage features on the site as long as prior consultation is made with the communities, alternate sites are provided and appropriate compensation is paid.

CULTURAL HERITAGE

No tomb / grave site is located on the Dilla RTC the site however there is an Orthodox Church, Chichu St. Gebreal Church, located approximately 200m south of the RTC Site. The church is located on a hill and is therefore elevated above the RTC site (**Figure 8-62**).

Figure 8-62: Photograph showing the location of the Chichu St. Gabreal Orthodox Church in rleation to the RTC site

8.17.3 SOCIO-ECONOMIC PROFILE OF PEOPLE IN THE PROJECT AREA (BASED ON WSP SURVEY)

The ESIA team, made up of local specialists guided by WSP, carried out a household survey in Yirga Alem and the Dilla towns, where based on the resettlement process initiated by authorities, over 1,700 people could be economically and/or physically displaced.

The ESIA team was targeting mainly those people who identified themselves as being affected by the project (and therefore covered by the resettlement process initiated by local authorities) and who still reside at the site. The ESIA team thus interviewed people from 289 households who confirmed to be affected by the project and currently reside in the vicinity of either the Yirga Alem IAIP or Dilla RTC sites. As the resettlement process had already been started by local authorities prior to the ESIA team involvement in the project, it was not possible or practical to locate and interview all 379 households who were surveyed by the government authorities back in 2016, as some of them have moved on.

In order to gain a wider socio-economic profile, the ESIA team also conducted surveys in the areas close to the project site that were identified as being unaffected by the project, interviewing a further 74 people.

The questions posed to the interviewees were aimed at collecting the relevant household and demographic information of not only the person who was interviewed but also members of their family, thus collecting the data on the wider circle of local residents and obtaining more detailed socio-economic profile of local people.

GENDER AND AGE

Both women and men were encouraged to participate in the household survey. Both resulted in similar outcomes, with approximately 86.5 % and 13.5 % of the questionnaires being answered by men and women, respectively (**Figure 8-63**).

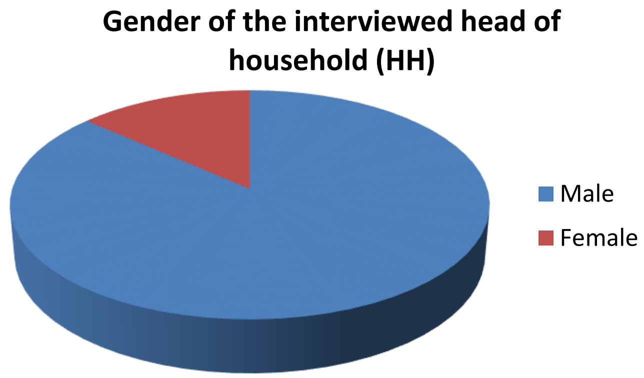

Figure 8-63: Respondents' gender

All of the respondents chose to disclose their age. 21.5 % of the questionnaires were answered by people who were between 16-30 years of age, 46.3 % were between 31-45 year olds, 21.2 % were between 46-60 year olds and 11.0 % were >66. Over two thirds of all respondents were noted to be young, i.e. being in their mid-teens to mid-40s (68 %) (see **Figure 8-64** below). Some respondents stated that they had up to 10 members living in the residence. When considering the total household population, 39 % were between 0-15 years of age, 36 % were between 16-30 years of age, 16.4 % were between 31-45 year olds, 6.0 % were between 46-60 year olds and 2.6 % were >66 (**Figure 8-65**).

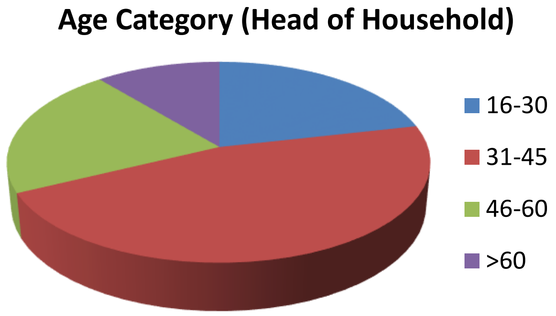

Figure 8-64: Age of Heads of Household

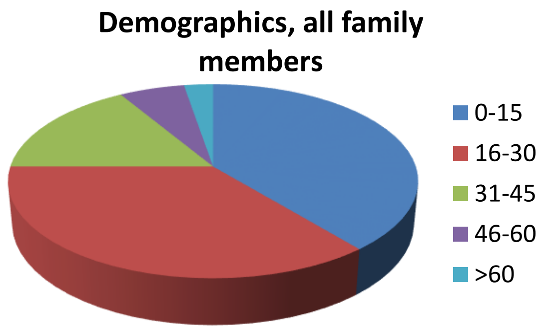

Figure 8-65: Demographics, all family members

EDUCATION

The educational profile has been further enhanced by the additional analysis of the education level of the interviewee's family members within each household visited. The extended collection of the education data on other family members revealed that **87% of respondents who are over 45 years old** (46-60 and >60 age) reported as having **had only primary (35%) or no form of education (52%).**

However, in the 16-30 year age bracket the majority had either a primary education (45.5%), high school education (40.4%), a Technical Diploma (8.6%) or a Higher/University Degree (2.5%). In other words, the opposite is true for the younger generation in the project area, where 51% of the younger category has received at least secondary education and 12% have undertaken secondary education or higher. Only 3% of 16-30 year old respondents had received no education.

In total, **close to 20% of all respondents had not finished their basic schooling or had no education. Over half of all family members (50.4%) included in the surveys finished a primary school education at a minimum. This figure is lower than the reported national statistics**, with 48% of females and 37% of males having never attended school, receiving only some or no primary education.

The surveys showed that a lower percentage of family members went on to further education, with 4% and 1.8% as having a technical diploma and a Higher/University Degree education level, respectively. In summary, low education attainment levels were noted among the interviewed respondents, where the majority of interviewees and their immediate adult family members mostly had either no education or finished at primary school, while the opposite is true for the younger generation who received a much better level of education. This disparity is shown in the **Figure 8-66** below.

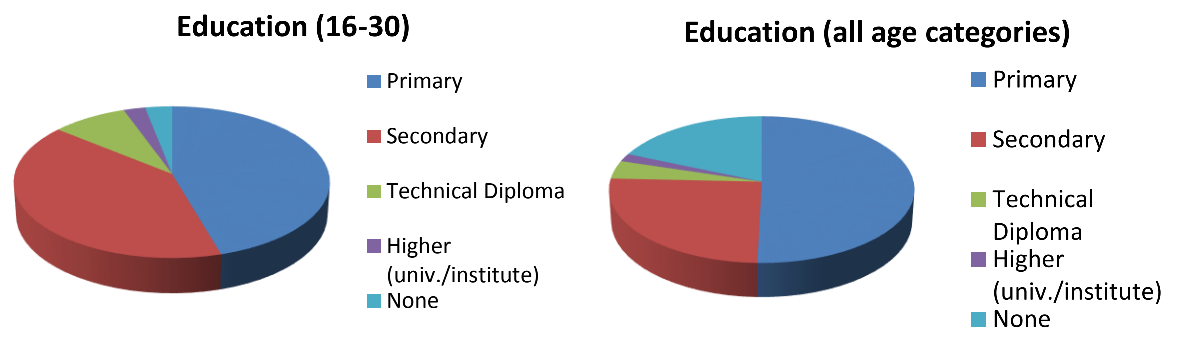

Figure 8-66: Reported education level of group aged 16-30 and for all age categories

EMPLOYMENT

75% of the head of household respondents stated that they were self-employed farmers. Other types of occupation among the interviewed heads of households included business and trade (12%), civil servant (11%), pensioner (1%), unemployed (0.5%) and other (<1%). It should be noted that no additional details were recorded if the respondent selected 'other' (**Figure 8-67**).

The employment profile of the rest of the family members shows that over a quarter (27.4%) of all adult family members (spouses, sisters, brothers, etc.) defined themselves as a farmer, while 3.7% of them defined themselves as either a civil servant or employed within a business or trade (5.3%) (see **Figure 8-67)**.

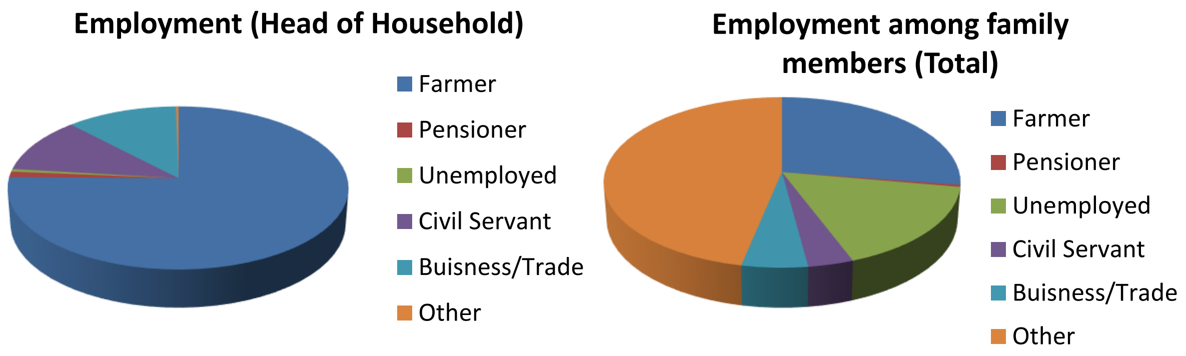

Figure 8-67: Employment among Heads of HH and in total among family members

The questionnaires showed that **16.4% of all family members were unemployed**. **This is a significantly lower level of unemployment that was expected in the project area**.

ASSET OWNERSHIP

Most of the respondents have irregular and unpredictable income (derived mainly through agricultural activities) and ownership of electronic goods in the interviewed households was low.

Whilst 79% of the surveyed respondents stated they owned a mobile phone, a much lower percentage of respondents confirmed they owned other electrical items, with a television owned by 9.6%, a satellite dish by 6.6%, a landline telephone 1.75%, the internet by 0.6% and only 0.3% of the respondents had access to a washing machine and refrigerator in their homes.

99% of the surveyed respondents are currently living in houses (with an average of 2 floors) or have a plot of land that they cultivate. The average size of land currently in use, including agricultural and the property was 1,000 m^2. Furthermore, the results demonstrate how important animal husbandry is for supplementary income in the survey area, with 34% owning goats, 83% owning chickens, 46.8 % owning cows and 27.5% owning sheep. In addition, 16% stated that they owned donkeys, 8.8% owned an ox and 0.6% owned a horse.

The majority of surveyed respondents did not own any form of personal transport (car or bike), with only 1.7% owning a car and 13.2% owning a bike/moped.

The survey asked respondents to list any areas of cultural heritage within the area. 60% of the respondents stated that there were areas of cultural significance located nearby, which ranged from 5 km to 35 km. Respondents were also asked the distance to the nearest cemetery from their home, this ranged from 0.5 km to 15 km, with an average of 1.84 km.

HOUSEHOLD INCOME AND EXPENDITURES

Questions about people's income and expenses are traditionally challenging and a high percentage of people often opt out and chose not to answer such questions. In the case of this socio-economic survey, the survey team made an effort to engage with people and explained at length why this data is being collected. As a result all of the respondents agreed to share the details on their income.

The majority of respondents (98%) indicated that they derive most of their income from farming/ agricultural activities or from other forms of employment (business/trade or formal employment). In addition, 1.9 % of interviewed households supplemented their income from other economic undertakings. The alternative forms of income (separate from occupational/salaried employment) were reported by the respondents who regularly source their income from rented property, social security benefits and remittances from other family members.

Among the respondents, the average household income from all livelihood sources and obtained from all working age family members totals to approximately 6,734 Birr/month (equivalent to $244/month, Jan 2018 exchange rate). The estimated annual per capita/person household income data from the WB report (2016) shows that an average per capita annual income in Ethiopia is $660/person. Assuming that there are at least three working adults in an average household (statistically, 4.8 people per household in Ethiopia), the obtained income data is broadly in line with the World Bank 2016 data.

When asked about their monthly expenditures, 94.2% of respondents indicated that they spend most of their monthly income on food. Thus, most of the people cultivating land in the project area will be severely affected if their access to land is disrupted, leading to significant reduction of their income and in most cases, future livelihood.

The next most important expenditures for the respondents appeared to be 'schooling', an answer given by 3.3 % of respondents. Other expenditures included 'housing' which was given by 1.4 % of respondents and 'health' which was also given by 1.1% of respondents.

SOURCES OF FRESHWATER

It was reported that only 3.1% of the households obtain freshwater from the lorry that regularly makes water deliveries. The main source of freshwater was identified as water pump, with 57.0% of households stating it as their main source, whilst 38.3% obtained freshwater from a well and a further 1.6% reported that they attain freshwater through 'other' resources. It should be noted that a number of respondents did not disclose their source of fresh water (**Figure 8-68**).

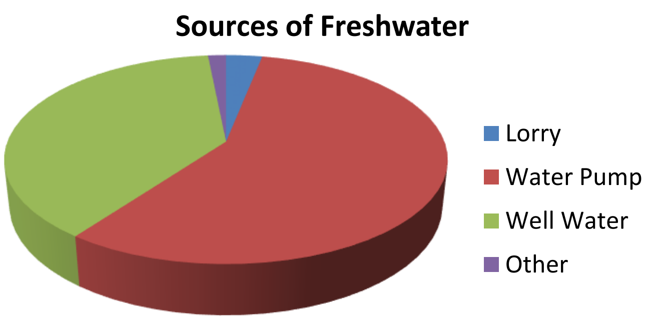

Figure 8-68: Sources of Freshwater

HEALTH SITUATION

Only 6.3% of the respondents indicated that at least 1 member of their household has a disability or an illness. The disabilities or illness within the households were noted down in the questionnaires as either a mental disorder, paralysis, blindness, broken leg and hearing problems or deafness.

The respondents listed the following top diseases to have affected members of their household in the past three years: common cold, typhoid, malaria, tuberculosis and hypertension.

The survey asked questions regarding recent deaths and births in families. 10% of the respondents reported that there had been one birth in the household within the last year, whilst only one household (1.6%) stated that a death had occurred within the last year. The cause of death was not stated.

PROJECT EXPECTATIONS

Most of the respondents (93%) were aware of the Project, of which most (95%) of them have primarily learnt about through local government officials and the resettlement process. Others respondents stated they learnt about the Project through other sources of information, including, friends and family (2.9%), the media (0.9%), the local community (1.5%). It should be mentioned that some respondents heard about the Project through more than one source of information.

93% of the respondents had a positive attitude towards the Project. The positive opinions were largely reported to be due to expectations related to an increase in the number of available jobs as well as the Project contributing to the development of area and country.

Only 1.6% of respondents reported expecting some negative impacts from the Project, which was due to the concern of displacing of farmers with little or no compensation. 5.5% of the respondents had a neutral outlook on the project, however, these responses all came from surveyed households that were not being affected.

9 IDENTIFICATION OF POTENTIAL IMPACTS

The purpose of the ESIA process is to assess and investigate the identified potential impacts that are most likely to be significant. This chapter includes physical, biological and social impacts associated with the proposed project.

The information which is presented below is a consolidation of the identified impacts associated with the proposed SNNP IAIP and RTC developments. These impacts have been sourced from various specialist reports included within **Appendix C**, refer to Appendices C-1 to C-12 for the full reports.

The technical impact assessment ratings tables have been provided for all specialist studies within **Appendix D**.

9.1 SOILS

The purpose of this section is to establish the extent to which agricultural soils will be removed from the site as a result of the proposed SNNP IAIP and RTC site developments and to identify potential risks to the identified soils and recommend associated mitigation measures. This was established by undertaking a fertility analysis of the soils sampled at the sites and calculating the potential risks that the proposed development will pose to the soils, with and without mitigation measures being put in place.

The description is based on primary data obtained from site investigations. **Table 9-1** summarises the impacts identified at both the SNNP IAIP and RTC sites as being significant in terms of soil, land use and land capability. To view the full report with regards to potential impacts on soils within the SNNP Region, refer to **Appendix C-1.**

Table 9-1: Potential Impacts on Soils in the SNNP Region

Impact number	Description	Character	Ease of Mitigation	Pre-mitigation Rating	Post-mitigation Rating
CONSTRUCTION					
1	Erosion Soil erosion is already a significant problem at the IAIP site. The soils at both sites are erosive. Development of these areas will lead to further erosion during the construction phases.	Negative	Low	Major	Moderate
2	Sedimentation The risk of sedimentation is directly linked to the risk of erosion, as eroded soil particles will end up in the nearby watercourses as sedimentation. As erosion is a significant risk at these sites and they are close to watercourses, so is sedimentation.	Negative	Low	Major	Moderate

Impact number	Description	Character	Ease of Mitigation	Pre-mitigation Rating	Post-mitigation Rating
3	Loss of topsoil Although the topsoil will be lost from these sites during the construction phase, it can potentially be transferred to an alternative area for continued cultivation.	Negative	High	Moderate	Negligible
4	Compaction Significant soil compaction will occur in some areas of the sites during the construction phase, changing the soils' original structure.	Negative	Moderate	Major	Moderate
5	Change in surface profile In order to create level platforms for the agri-industrial zone buildings, the surface profile of the sites will be changed during the construction phase. This will affect water flow, sedimentation and erosion patterns.	Negative	Nil	Major	Major
6	Change in land use The proposed development activities will result in a permanent change of land use during the construction phase. Land use will change from grazing to an agri-industrial zone.	Negative	Nil	Major	Major
7	Change in land capability The proposed development will permanently alter the land capability of the site.	Negative	Nil	Major	Major
8	Dust creation Bare surfaces and soil stockpiles pose the risk for high amounts of dust creation.	Negative	Moderate	Moderate	Minor
9	Soil Contamination Contamination of the soils may occur due to the large vehicles; on-site pollutants' contact with the well-drained soils will need to be limited.	Negative	Moderate	Major	Minor
OPERATIONAL					
1	Erosion Soil erosion is already a significant problem at the	Negative	Low	Major	Moderate

Impact number	Description	Character	Ease of Mitigation	Pre-mitigation Rating	Post-mitigation Rating
	IAIP site. The soils at both sites are erosive. Development of these areas will potentially lead to further erosion during the operation phase.				
2	Sedimentation The risk of sedimentation is directly linked to the risk of erosion, as eroded soil particles will end up in the nearby watercourses as sedimentation. As erosion is a significant risk at these sites and they are close to watercourses, so is sedimentation.	Negative	Low	Moderate	Minor
3	Compaction Large amounts of compaction will occur during this phase, resulting in the soil structures being permanently changed.	Negative	Nil	Major	Major
4	Dust creation Bare surfaces and soil stockpiles pose the risk for high amounts of dust creation.	Negative	Moderate	Moderate	Minor
5	Contamination Contamination should be prevented otherwise well-drained after contact with the pollutants.	Negative	Moderate	Moderate	Minor
DECOMMISSIONING					
1	Erosion Soil erosion is already a significant problem at the IAIP site. The soils at both sites are erosive. Development of these areas will potentially lead to further erosion during the decommissioning phase.	Negative	Low	Major	Moderate
2	Sedimentation The risk of sedimentation is directly linked to the risk of erosion, as eroded soil particles will end up in the nearby watercourses as sedimentation. As erosion is a significant risk at these sites and they are close to	Negative	Low	Moderate	Minor

Impact number	Description	Character	Ease of Mitigation	Pre-mitigation Rating	Post-mitigation Rating
	watercourses, so is sedimentation.				
3	Dust creation Bare surfaces and soil stockpiles pose the risk for high amounts of dust creation.	Negative	Moderate	Major	Minor
4	Soil Contamination Contamination of the soils may occur due to the large vehicles; on-site pollutants' contact with the well-drained soils will need to be limited.	Negative	Moderate	Major	Minor

The soil impacts identified above can be suitably mitigated through the implementation of protection strategies, refer to the Environmental and Social Management Plan (ESMP) included in **Chapter 11**.

The residual impacts on the soil as a result of the development will include the following:

- **Soil Erosion**: As the soils found at the SNNP sites are erosive, excavating the soils in order to develop the SNNP IAIP and RTC will lead to further soil erosion. This can be mitigated against to an extent through the implementation of mitigation measures, but any excavation of these soils is generally likely to lead to further erosion.
- **Sedimentation**: A residual soil erosion impact will lead to a residual sedimentation impact as eroded soil particles will enter the nearby watercourses as sediment.
- **Compaction**: All soils that have been compacted will have lost their original structure permanently.
- **Change in surface profile**: As the site will be levelled for the development, the land surface profile will be permanently altered.
- **Change in land use**: As the soils will be excavated, compacted and possibly sterilized, the land use will very likely change from arable permanently.
- **Change in land capability**: As the soils will be excavated, compacted and possibly sterilized, the land capability will very likely change from arable permanently.
- **Soil Contamination**: Contaminated soil is expensive to rehabilitate and contamination entering the well-drained soils of the SNNP sites is likely to enter the surrounding water resources.

Mitigation measures can be very expensive and require appropriately-skilled personnel to be a part of an impact mitigation team.

9.2 SURFACE WATER (HYDROLOGY)

This section of the report is to identify the potential risks associated with the surface water at the proposed project site.

The storm water management plan developed by MACE was reviewed[8]. The objective of the storm water management plan review is to determine if the design appropriately manages the storm water runoff according to applicable legislation highlighted below[9].

[8] For a comprehensive list of drawings and document that were reviewed refer to the specialist report attached as Appendix C-2.

[9] Please note that the sizing of storm water infrastructure was not considered as part of the review.

- African Development Bank Group - Safeguards and sustainability series, Volume 2, Issue 1, December 2015: Integrated Safeguards System;
- UNOPS - Design Planning Manual, Version 1, 2014;
- IFC World Bank Group - Environmental Health and Safety (EHS) Guidelines: General Environmental Guidelines, 2007;

The water quality analysis was undertaken in accordance to the general liquid effluent quality with regards to discharge to surface water within the IFC World Bank Guidelines (IFC, 2007). The water quality monitoring programme was thus developed in accordance with the IFC World Bank Group Guidelines (IFC, 2007).

The main issues and potential impacts associated with the proposed project were determined at a desktop level, based on existing information, as well as from site investigations and specialist input.

The SNNP IAIP (Yirga Alem) drainage system has 26 discharge points. Clean water drains situated along the western boundary of the site will direct clean water into the Gidabo River. Most of the runoff generated on the site is discharged to the surrounding environment. The northern section of the site drains towards a summer storage tank where captured runoff water will be used within the operations during the dry season. Any overflow of the summer storage tank will spill into the Gidabo River. Runoff water from the sewage treatment plant will be captured within the summer storage tank.

The SNNP RTC (Dilla) drainage system is a collection of drains that direct water to three (3) discharge points. No runoff water is captured on site and all runoff is discharged to the road on the western side of the site. The area of concern within this storm water design is that runoff generated on the sewage treatment plant is contained in the stormwater runoff that is discharged offsite.

Table 9-2 identifies the potential impacts on surface water and the significance of the impacts. To view the full report with regards to potential impacts on soils within the SNNP Region, refer to **Appendix C2.**

Table 9-2: Potential Impacts on Surface Water in the SNNP Region

Impact number	Description	Character	Ease of Mitigation	Pre-mitigation Rating	Post-mitigation Rating
CONSTRUCTION					
1	Contamination Hydro-carbon contamination of surface water features from earth-moving machinery and vehicles.	Negative	Moderate	Moderate	Minor
2	Sedimentation Sedimentation of the Gidabo River	Negative	Moderate	Moderate	Minor
OPERATIONAL					
1	Hydrological regime The proposed development will alter the hydrological regime and thereby result in a change in runoff volume.	Negative	Moderate	Moderate	Minor
2	Hydrological regime The proposed development will alter the hydrological regime and thereby result in a change in runoff velocity.	Negative	High	Moderate	Minor

Impact number	Description	Character	Ease of Mitigation	Pre-mitigation Rating	Post-mitigation Rating
DECOMMISSIONING					
1	Contamination Hydro-carbon contamination of surface water features from earth-moving machinery and vehicles.	Negative	Moderate	Moderate	Minor
2	Sedimentation Sedimentation of the Gidabo River	Negative	Moderate	Moderate	Minor

The surface water impacts identified above can be suitably mitigated through the implementation of protection strategies, refer to the ESMP included in **Chapter 11**. Limited to none residual impacts on the surface water as a result of the development are anticipated if the mitigation measures are implemented correctly.

9.3 GROUNDWATER (GEOHYDROLOGY)

Based on primary data obtained, local communities in both the IAIP and RTC areas rely heavily on groundwater, which makes up the bulk of the domestic supply to the region. There are two main aquifer types in the region: a shallow, weathered aquifer and a deeper fractured aquifer. The weathered aquifer represents a minor aquifer, which is not heavily exploited and has a low groundwater potential. The fractured aquifer has a far higher groundwater potential, and is targeted for larger scale groundwater supply, with a number of productive water supply boreholes being targeted at both the IAIP and RTC sites.

Groundwater quality in the area is generally good. The main source of potential groundwater contamination at both the IAIP and RTC sites is micro biological contamination from faecal waste originating from septic tank and sewage system discharge, infiltration of domestic waste and unlined pit latrines and livestock waste. However, the risk of contamination is slightly higher due to the increased population density in the area.

The potential impacts on the groundwater is presented in the table below. To view the full report with regards to potential impacts on ground water within the SNNP Region, refer to **Appendix C3.**

Table 9-3: Potential Impacts on Ground Water in the SNNP Region

Impact number	Description	Character	Ease of Mitigation	Pre-mitigation Rating	Post-mitigation Rating
CONSTRUCTION					
No construction phase impacts to the hydrogeological environment are expected.					
OPERATIONAL					
1	Lowering of groundwater levels through abstraction of groundwater for use at the IAIP and RTC sites	Negative	High	Moderate	Minor
2	Contamination of groundwater resources from contaminated surface water runoff or	Negative	Low	Moderate	Minor

Impact number	Description	Character	Ease of Mitigation	Pre-mitigation Rating	Post-mitigation Rating
	subsurface leakages from underground chemical storage and/or effluent systems				
3	Loss of recharge area for the springs through reduction of permeable surface	Negative	None	Minor	Minor
DECOMMISSIONING					
No decommissioning phase impacts to the hydrogeological environment are expected.					

Based on the findings of the impact assessment, it has been concluded that the development and operation of the SNNP IAIP and RTC will have a minor impact on the receiving groundwater environment.

The groundwater impacts identified above can be suitably mitigated through the implementation of protection strategies, refer to the ESMP included in **Chapter 11**.

9.4 WETLANDS

The Integrated Water Resource Management (IWRM) is an internationally-accepted approach to sustainable Water Resource Management. It recognises the inter-relatedness and relationship between watercourse level processes and components (resource quality characteristics). An activity associated with the existing development can impact any of the resource ecosystem drivers (flow regime, water quality, geomorphological) or responses (habitat, biota) and this will have a knock-on effect on potentially all the other drivers and or responses. Therefore, when assessing an activity, the impact that specific activity may have on all the resource quality characteristics is assessed. The majority of activities will not only affect one characteristic due to their complex interrelatedness.

The potential direct and indirect impacts of the proposed development on the identified wetland habitats are discussed below.

The proposed development may potentially impact the depression systems, however the area where the proposed activities are proposed to occur has already been significantly modified by the current and past land and water use activities. The majority of the potential impacts will occur during the construction phase. The long-term impacts that are likely to occur relate to the onsite stormwater management during the operational phase of the proposed development.

If the development progresses there will be direct loss of wetland habitat resulting in the subsequent loss of the goods and services currently provided by the wetland systems. Although there is proposed stormwater infrastructure which manages surface water flow, the natural flow regime is still being impacted upon. The development of the IAIP will result in reduced vegetation cover, and the installation of drainage systems. This will direct water away from subsurface pathways to overland flow into the stormwater drainage system. The difference in permeable area between the undeveloped site and that of the proposed development may result in: the increase in flood frequency and intensity, decrease infiltration, alter flow patterns, increase concentrated runoff, potential erosion (i.e. increase in flow velocity, especially considering the high erodibility of the soils) and widening of river's banks and channel in the surrounding areas. It is recognised that some level of permeability has been designed for within the drain structures. Effective stormwater management would allow for the release of the surface water runoff in a controlled manner, with minimal impact on the surrounding environment. The quality of the surface water runoff from the proposed development may result in the degradation of

water quality downstream of the site. Again an effective stormwater management plan for the proposed development, including structures such as grease traps, would mitigate against this impact.

The quality of the surface water runoff from the proposed development may result in the degradation of water quality downstream of the site. Again an effective stormwater management plan for the proposed development, including structures such as grease traps, would mitigate against this impact.

Mitigation requires proactive planning that is enabled through a mitigation hierarchy. This is in line with relevant requirements in the African Development Bank's operational safeguards (ADB 2015). Its application, is intended to strive to first avoid disturbance of ecosystems and loss of biodiversity, and where this cannot be avoided altogether, to minimise, rehabilitate, and then, as a last resort, compensate for and offset any remaining significant residual negative impacts on biodiversity.

The implementation of this mitigation hierarchy is required to be shown as the complete removal of the identified systems and compensation/offset (final step in hierarchy) of removed systems can only occur once the avoid, minimise and rehabilitate steps have been considered and proved to be not possible. Ideally 100% of the wetland systems would be maintained and incorporated into the detailed designs of the IAIP ('avoid' in the mitigation hierarchy), however it is noted that this may not be feasible due to social and economic factors and project viability criteria. It is also noted that the systems proposed to be removed are small isolated systems low in provision of goods and services, therefore considered low in conservation value.

The specific impacts outlined in **Table 9-4**, are overarching general impact categories that may result as a consequence of the proposed development on the wetland systems. These are broad categories that encapsulate the impacts that could potentially affect the functioning of a wetland system. To view the full report with regards to potential impacts on wetlands within the SNNP Region, refer to **Appendix C4**.

Table 9-4: The Potential Impacts on wetlands in the SNNP IAIP

Impact number	Receptor	Character	Ease of Mitigation	Pre-mitigation Rating	Post-mitigation Rating
CONSTRUCTION					
1	Direct loss/ degradation of natural wetland habitat & biota (W1-7; R1)	Negative	Nil	Major	Major
2	Hydrological functioning/ regime modifications (W1-7; R1)	Negative	Low	Major	Moderate
3	Erosion and Sedimentation (W3; R1)	Negative	Moderate	Major	Minor
4	Water Quality (W3; R1)	Negative	High	Moderate	Minor
OPERATIONAL					
1	Direct loss/ degradation of natural wetland habitat & biota (offsetting wetland loss through the creation and management of artificial wetland habitats)	Positive	High	Negligible	Major
2	Hydrological functioning / regime modifications (Artificial systems; W3; R1)	Negative	High	Moderate	Minor
3	Erosion and Sedimentation (W1, W3-5)	Negative	Moderate	Major	Minor

Impact number	**Receptor**	**Character**	**Ease of Mitigation**	**Pre-mitigation Rating**	**Post-mitigation Rating**
4	Water Quality (Artificial systems; W3; R1)	Negative	Moderate	Moderate	Minor
DECOMMISSIONING					
1	Direct loss/ degradation of natural wetland habitat & biota (Artificial systems; W3; R1)	Negative	Low	Major	Negligible
2	Hydrological functioning/ regime modifications (Artificial systems)	Negative	Low	Moderate	Moderate
3	Erosion and Sedimentation (Artificial systems; W3; R1)	Negative	Moderate	Major	Minor

Based on the findings of the impact assessment, it has been concluded that the wetland impacts identified above can be suitably mitigated through the implementation of protection strategies. Therefore the loss wetland habitat, which is the most significant impact, can be mitigated against to result in 'no net loss of biodiversity' as a result of the proposed development

Refer to the ESMP included in **Chapter 11** for details on the required mitigation measures to be implemented.

9.5 AIR QUALITY

The purpose of the Air Quality Impact Assessment was to identify the potential impacts and associated risks posed by the proposed IAIP site on the air quality of the area and make informed decisions on the way forward in order to ensure that these risks do not result in unacceptable social or environmental risk.

Table 9-5 below provides a breakdown of potential construction, operational and decommissioning phase impacts on air quality and presents the associated ratings. To view the full report with regards to potential impacts on air quality within the SNNP Region, refer to **Appendix C5**.

Table 9-5: The Potential Impacts on Air Quality in the SNNP Region

Impact number	Receptor	Character	Ease of Mitigation	Pre-mitigation Rating	Post-mitigation Rating
CONSTRUCTION					
1	Increased particulate and gaseous concentrations impacting residential receptors located within immediate vicinity of site boundary.	Negative	Moderate	Moderate	Minor
2	Increased particulate and gaseous concentrations impacting residential	Negative	Moderate	Minor	Negligible

Impact number	Receptor	Character	Ease of Mitigation	Pre-mitigation Rating	Post-mitigation Rating
	receptors beyond site boundary.				
OPERATIONAL					
1	Increased particulate and gaseous concentrations impacting residential receptors located within immediate vicinity of site boundary.	Negative	Moderate	Moderate	Minor
2	Increased particulate and gaseous concentrations impacting residential receptors beyond site boundary.	Negative	Moderate	Minor	Negligible
DECOMMISSIONING					
1	Increased particulate and gaseous concentrations impacting residential receptors located within immediate vicinity of site boundary.	Negative	Moderate	Moderate	Minor
2	Increased particulate and gaseous concentrations impacting residential receptors beyond site boundary.	Negative	Moderate	Minor	Negligible

It should be noted that the above ratings are based on a qualitative assessment of the potential impacts. Further quantification of the potential impacts with dispersion modelling is recommended once detailed source and emissions information is available to accurately assess the potential impacts based on compliance/non-compliance with the applicable guidelines/standards.

Based on the findings of the impact assessment, it has been concluded that the development and operation of the SNNP IAIP and RTC will have a minor impact on the receiving air quality environment. The impacts identified above can be suitably mitigated through the implementation of protection strategies, refer to the ESMP included in **Chapter 11**.

9.6 CLIMATE CHANGE

Climate change will have key impacts on agriculture, livestock, water and human health in Ethiopia. In particular, this will result in:

- Reduced yields and/or crop failure, reduced soil moisture availability; and increased evapotranspiration and water stress;
- Increased incidence of pests and diseases, reduced feed and water sources, and increased livestock mortality;
- Changing ranges of vector-borne diseases and increased risk from waterborne diseases;
- Reduced water quality and quantity, drying of wetlands and freshwater sources, disruption of hydropower generation;

- Changing ranges of vector-borne diseases; and
- Increased risk from waterborne diseases.

Despite the challenges, Ethiopia hopes to capitalise on its current economic growth by becoming more resilient to the impacts of climate change while developing its economy in a carbon neutral way by transforming development planning, investments and outcomes.

The country's Climate Resilient Green Economy Strategy (CRGE), which was published in 2011, sets out this vision (International Institute for Environment and Development). It is viewed as an opportunity to transform the country's development model by leaping to modern energy-efficient development trajectories.

Ethiopia is one of the few countries to have formally merged its aims of developing a green economy and greater resilience to climate change under a single policy framework in support of its national development objectives. While the government is still preparing its climate resilience objective, the Green Economy component of the CRGE has already been developed (International Institute for Environment and Development). It aims to develop Ethiopia's green economy by:

- Improving crop and livestock production practices to improve food security and increase farmer's incomes while reducing emissions;
- Protecting and re-establishing forests for their economic and ecosystem services, including as carbon stocks;
- Expanding electricity generation from renewable energy sources for domestic and regional markets; and
- Advancing to modern and energy-efficient technologies in transport, industrial sectors, and buildings.

To view the full report with regards to potential impacts on climate change, refer to **Appendix C6**.

9.7 GREENHOUSE GAS EMISSIONS

Greenhouse gas emissions in Ethiopia increased by 86% from 1993 - 2011. Through the Intended Nationally Determined Contribution, Ethiopia pledges to cap 2030 greenhouse gas emissions at 145 $MtCO_2e$, a 64% reduction from projected business as usual emission levels in 2030. The pledge includes greenhouse gas reductions from agriculture, forestry, industry, transport and buildings sectors.

The total GHG emissions for the Yirga Alem IAIP site was calculated to be approximately 161 113.77 t CO2eq based on the above approach. For the assessment a worst case scenario approach was calculated whereby all electricity required for the sites is generated via coal-fired operations. As such Scope 2, coal-fired operations, was shown to contribute the highest GHG emissions to be emitted in terms of the SNNP Project (making up approximately 81% of the total GHG emissions emitted). CH_4 and N_2O emissions are marginal from all sources, being significantly over shadowed by CO_2 emissions which account for 99.5% of total CO_2eq emissions associated with the SNNP Project activities (**Table 8-29** and **Figure 8-33**).

Table 9-6: Estimated greenhouse gas emissions for the SNNP IAIP and RTC

Scope	Source	Main Activity	CO_2 (tons/year)	CH_4 (tons/year)	N_2O (tons/year)	CO_2e (tons/year)
Scope 1	Coal consumption	Coal-fired boiler operations	29833.06	7.88	140.97	29981.91
Scope 2	Electricity generation at IAIP	Coal-fired operations	127 029.15	33.57	600.23	127 662.96

Scope	Source	Main Activity	CO_2 (tons/year)	CH_4 (tons/year)	N_2O (tons/year)	CO_2e (tons/year)
	Electricity generation RTC	Coal-fired operations	3 451.68	0.91	16.31	3 468.91
TOTAL GHG EMISSIONS						**161 113.77**

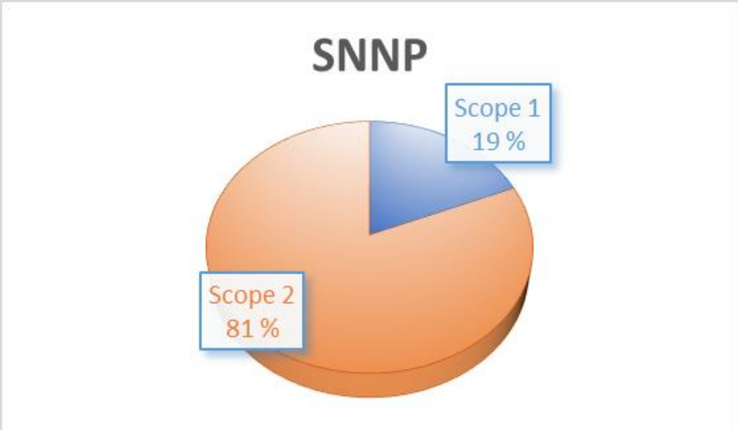

Figure 9-1: CO_{2eq} percentage contribution from Scope 1 and Scope 2 sources at SNNP

It is important to note that GHG emissions from vehicles have not been accounted for as accurate vehicle counts from the IAIP to the RTC is unknown. Credibility of such data is key to ensure that the footprint is transparent, accurate and reliable for reporting and without such information, a true representation of the GHG emissions emitted from vehicles cannot be determined.

It is therefore noted that the total greenhouse gas emissions estimated for the Project are considered a worst case scenario. Should the IAIP and RTC facilities be provided electricity from the national grid the greenhouse gas emissions resulting from the generation of the required electricity is drastically reduced (in the region of 80% reduction) due to the use of renewable resources as the predominant energy source for the generation of electricity.

To view the full report with regards to potential impacts on climate change, refer to **Appendix C6**.

9.8 NOISE

The current noise climate is typically rural, with very limited anthropogenic influences. The site currently consists of agricultural activities, mixed vegetation and low density settlements, all of which do not generate significant levels of noise.

In terms of the construction phase, based on a worst-case cumulative sound power level of 116.3 dB(A) stemming from all anticipated construction equipment to be operational during the construction phase (refer to **Table 8-30**), the resultant noise levels are anticipated to be highest closest to the source and tapers off as distance from the source increases, as would be expected. Beyond 50 m from the source, noise levels will reduce considerably, with noise levels at around 78 m from the source dropping to below the industrial guideline rating level of 70 dB(A). From 438 m from the construction activities, noise levels will decrease to below the residential guideline level of 55 dB(A).

Based on this worst-case assessment, there will be no resultant acoustic impacts on the surrounding towns, which are all located greater than 1 km from the site. Neighbouring homesteads (up to 500 m from the site boundary) will be directly impacted by construction activities, particularly when construction occurs on the nearest site boundary to a receptor in question. Receptors further than 500 m from the IAIP site will be minimally impacted by construction activities and owing to the low current background noise levels may experience slight increases in existing noise levels as a result of

the construction activities. Additionally, the ridge located alongside the eastern boundary of the site, will further diminish noise at receptors in close proximity to the more populated Aposto town.

Noise impacts are much more discernible at night, due to the lower existing noise levels. It is envisaged that the construction of the IAIP will only occur during the day-time hours and as such no project-related acoustic impacts are anticipated at night.

In terms of the operation phase, based on a worst-case cumulative noise level of 107.6 dB(A) stemming from activities at the meat processing unit (refer to **Table 8-30**), the resultant noise levels are anticipated to be highest closest to the source and tapers off as distance from the source increases, as would be expected. With noise levels at around 30 m from the source dropping to below the industrial guideline rating level of 70 dB(A). From 160 m from the processing activities, noise levels will decrease to below the residential guideline level of 55 dB(A). Noise impacts are much more discernible at night, due to the lower existing noise levels. It is understood that the operation of the IAIP will only occur during the day-time hours and as such no project-related acoustic impacts are anticipated at night.

It must be noted that these calculations are based on the fact that the noise sources are all exposed to the open air and not enclosed within a building. It is most likely that most units and processes will be enclosed within buildings with particular reference to the boiler and meat processing units. Boilers are generally enclosed within boiler houses. For hygiene purposes, any food processing facility will also be enclosed. This will result in significantly lower noise levels experienced in the ambient environment.

Table 9-7 identifies the potential impacts of increased noise levels which may be caused by the proposed project, as well as the severity of the impacts associated with each phase of the project.

To view the full report with regards to potential impacts on noise levels within the SNNP Region, refer to **Appendix C7**.

Table 9-7: Potential Impacts of Noise in the SNNP Region

Impact number	Receptor	Character	Ease of Mitigation	Pre-mitigation Rating	Post-mitigation Rating
CONSTRUCTION					
1	Construction phase impacts of noise on residential receptors within 500 m of the site boundary	Negative	Moderate	Major	Moderate
2	Construction phase impacts of noise on residential receptors beyond 500 m of the site boundary	Negative	Moderate	Moderate	Minor
OPERATIONAL					
1	Operational phase impacts of noise on residential receptors within 200 m of the site boundary	Negative	Moderate	Moderate	Minor
2	Operational phase impacts of noise on residential receptors	Negative	Moderate	Minor	Negligible

Impact number	Receptor	Character	Ease of Mitigation	Pre-mitigation Rating	Post-mitigation Rating
	beyond 200 m of the site boundary				
DECOMMISSIONING					
1	Decommissioning phase impacts of noise on residential receptors within 500 m of the site boundary	Negative	Moderate	Major	Moderate
2	Decommissioning phase impacts of noise on residential receptors beyond 500 m of the site boundary	Negative	Moderate	Moderate	Minor

The impact assessment has identified that the construction and decommissioning phases will generate the most significant impacts, however these can be effectively managed through the implementation of mitigation measures as identified in the ESMP (refer to Chapter 11).

9.9 TRANSPORT AND ACCESS

The expected produce through-put and related vehicle volumes for deliveries and distribution to and from the IAIP and the RTC is not known. MACE calculated the expected trip generation of the sites to determine the pavement structure requirements for the design life of the facilities. The method to calculate the Average Annual Daily Traffic (AADT) was as per the Ethiopian Roads Authority Manual for agri-processing and non-agri processing areas. The assessment was therefore based on these calculations. It is however noted that the interaction between community members using these routes with the increased Project traffic from the construction phase onwards, may increase the risk of traffic accidents.

A breakdown of potential construction phase, operational phase and decommissioning phase traffic related impacts and ratings are provided in **Table 9-8**.

To view the full report with regards to potential impacts on transport and access within the SNNP Region, refer to **Appendix C8**.

Table 9-8: Potential Impacts on Transport and Access in the SNNP IAIP

Impact number	Receptor	Character	Ease of Mitigation	Pre-mitigation Rating	Post-mitigation Rating
CONSTRUCTION					
1	Increased vehicle/vehicle and vehicle/NMT accident risks due to increased traffic volumes on the local road network.	Negative	Low	Minor	Minor
OPERATIONAL					
1	Increased vehicle/vehicle and	Negative	Low	Moderate	Minor

Impact number	Receptor	Character	Ease of Mitigation	Pre-mitigation Rating	Post-mitigation Rating
	vehicle/NMT accident risks due to increased traffic volumes on the local road network.				
DECOMMISSIONING					
1	Increased vehicle/vehicle and vehicle/NMT accident risks due to increased traffic volumes on the local road network.	Negative	Low	Minor	Minor

From the above assessment it is evident that the proposed Yirga Alem IAIP and Dilla RTC facilities will have traffic and safety impacts on the local road networks and residents within each area. However; the impact assessment has identified that the identified impacts can be effectively managed through the implementation of mitigation measures as included within the ESMP (refer to Chapter 11).

During the assessment additional recommendations have been identified, these are as follows:

- The vehicle accesses to the IAIP and the RTC must be designed to the relevant National standards, namely the Ethiopia Road Authority design standards.
- All parking provision is to be provided on-site, and parking on individual erven will be subject to the Development Control Regulations of the sites.
- There are residential areas in the vicinity of the IAIP, therefore public transport may still be required due to the large number of workers that will be employed on the IAIP. The type and extent of the services cannot be assessed at this stage, and may have to be provided in incremental stage as the number of workers on-site increases.
  - A suitable public transport stop should be provided on-site, to ensure safety of passengers waiting for transport.
  - Due to the location of the site, non-motorised transport will be present along the federal highway and access road to the site.
  - If feasible, an additional NMT access should be provided from the north and west of the site. This will allow a shorter and more direct access to the site from the surrounding areas, and will also decrease NMT movements along the access road and at the main access.
- As the Dilla RTC is located directly south of the town of Dilla, public transport may still be required to transport workers from the northern part of the town and surrounding areas.
  - A suitable public transport stop should be provided on-site, to ensure safety of passengers waiting for transport.
  - Due to the location of the site directly adjacent to the town, non-motorised transport is present along the federal highway.
  - It is recommended that NMT facilities (sidewalks) be provided for the property frontage of the RTC with the federal highway.
- It is recommended that due to the higher traffic volumes to and from the IAIP, and the single vehicle access, that the configuration of the access road intersection with the federal highway should have multiple lanes and turning lanes on the main road. This will assist to improve safety and operation of the access road intersection. The required road signs, road markings and street lighting should also be implemented at the access.
- The very low traffic volumes to and from the RTC does not justify additional turning lanes at the access intersections, and no intersection upgrades are recommended.

9.10 WASTE MANAGEMENT

The Yirga Alem and Dilla towns lack formally organised and advanced waste management systems such as collection, transport and disposal; therefore identifying the risks associated with waste management is necessary. **Table 9-9** below highlights the risks at each phase of the proposed project, by taking into account the current waste management programs at the IAIP site and RTC site.

Table 9-9: Potential Risks Associated with Waste Management in the SNNP Region

Impact number	Receptor	Character	Ease of Mitigation	Pre-mitigation Rating	Post-mitigation Rating
CONSTRUCTION					
1	Inappropriate disposal of construction waste including discarded or broken bricks, packaging and hazard demarcation tape	Negative	Moderate	Minor	Minor
2	Hazardous waste materials being stockpiled on bare ground presenting a potential for contamination of soils, surface and ground water.	Negative	Moderate	Moderate	Minor
3	Domestic waste such as food/meal debris, packaging and sanitary waste generated by construction staff	Negative	High	Major	Minor
OPERATIONAL					
1	Overfull waste bins littering streets and blockage of drainage channels	Negative	High	Major	Minor
2	Hazardous waste materials being stockpiled on bare ground presenting a potential for contamination of soils, surface and ground water.	Negative	Moderate	Moderate	Minor
3	Any wastes being ultimately disposed of at a landfill will contribute to the volumes of waste and hence the lifespan of the landfill.	Negative	High	Major	Minor

Impact number	Receptor	Character	Ease of Mitigation	Pre-mitigation Rating	Post-mitigation Rating
4	Where disposal occurs within an unlined landfill there is the potential for leachate to develop and drain into surface and groundwater resources.	Negative	Moderate	Major	Minor
DECOMMISSIONING					
1	Decommissioning waste: rubble, steel, glass, packaging and hazard demarcation tape.	Negative	High	Major	Minor
2	Hazardous waste materials being stockpiled on bare ground presenting a potential for contamination of soils, surface and ground water.	Negative	Moderate	Major	Minor
3	Domestic waste such as food/meal debris, packaging and sanitary waste generated by construction staff.	Negative	Moderate	Moderate	Minor

These impacts can be mitigated through proper management and control measures which are contained within a Waste Management Plan (WMP). A WMP has been developed for the SNNP IAIP and RTC sites and is attached as **Appendix C9**.

The WMP provides details on what waste management practices should be applied within the facilities, how waste will be managed and what responsibilities fall to the IPDC, Contractors and Enterprises. The WMP provides an order of preference for waste management options in line with the waste hierarchy. This is an organic document that will need to be regularly updated to include any changes that may occur in the science of waste management. Better waste management reduces environmental pollution; diversion of waste from landfill decreases the need for additional landfills; waste recovery, reuse and recycling reduce the consumption of natural resources, likewise the minimisation of waste.

9.11 VISUAL

The proposed IAIP development is situated in a rural area west of Yirga Alem town and the town of Aposto. The area is of low visual value. The visual absorption capacity is relatively good primarily due to the undulating nature of the topography.

In the context of the development level of Ethiopia, visual impacts arising from such mega projects are considered by the local community receptors to be positive in general. This is because the IAIP/RTC structures adds up to the overall modernization and development of the towns.

A breakdown of potential construction phase, operational phase and decommissioning phase visual related impacts and ratings are provided in **Table 9-10**.

To view the full report with regards to potential visual impacts within the SNNP Region, refer to **Appendix C10**.

Table 9-10: Potential Visual Impacts in the SNNP IAIP

Impact number	Receptor	Character	Ease of Mitigation	Pre-mitigation Rating	Post-mitigation Rating
CONSTRUCTION					
1	Construction equipment and dust	Negative	Low	Minor	Minor
2	Site clearing	Negative	Low	Minor	Negligible
3	Physical impact on landforms	Negative	Low	Minor	Negligible
OPERATIONAL					
1	Intrusion on the sense of place and scenic landscape	Positive	Not applicable	Moderate	Moderate
2	Light Pollution	Negative	Low	Moderate	Minor
3	Roads and /or road widening	Negative	Low	Minor	Negligible
DECOMMISSIONING					
1	Construction equipment and dust	Negative	Low	Minor	Negligible

The impact assessment has identified that the identified impacts can be effectively managed through the implementation of mitigation measures identified within the ESMP (refer to Chapter 11).

9.12 BIODIVERSITY

A biodiversity baseline survey of the Project area was undertaken in line with the AfDB Operational Safeguard 3 – Biodiversity, renewable resources and ecosystem services. The baseline sought to determine the occurrence and approximate abundance of sensitive species within the IAIP site footprint as well as those species in the area that would potentially be impacted upon by the proposed Project. The desk top and field assessment involved the following:

- Identification of protected biodiversity sites within 10km radius of the project area and include distance and direction to sites with appropriate mapping to show locations; including status of sites (i.e. are they internationally, nationally, regionally or locally protected under what legislation or not) and brief description of why sites are protected (i.e. habitat type, red list species etc.);
- Identification of non-protected areas within the vicinity of the Project area that may be sensitive to the development project (i.e. watercourses / wetland habitats);
- Descriptions of general habitat types located on site and provide a table outlining typical flora and fauna;
- Identification of all IUCN red list fauna and flora species that could potentially be present on site and identify all possible red data list species and their current status.

An assessment of the potential impacts associated with the proposed project was undertaken based on the findings of the baseline survey. **Table 9-11** below indicates how the biodiversity within the Yirga Alem IAIP region may be impacted by the proposed development. While **Table 9-12** below

indicates how the biodiversity within the Dilla RTC region may be impacted by the proposed development.

To view the full report with regards to potential biodiversity impacts within the SNNP Region, refer to **Appendix C11**.

Table 9-11: Potential Impacts on Biodiversity at the Yirga Alem IAIP in the SNNP Region

Impact number	Receptor / Impact	Character	Ease of Mitigation	Pre-mitigation Rating	Post-mitigation Rating
CONSTRUCTION					
1	Flora Deforestation and vegetation clearing	Negative	Moderate	Moderate	Minor
2	Fauna and Flora Habitat destruction	Negative	Moderate	Moderate	Minor
3	Fauna Road kills	Negative	Moderate	Minor	Minor
4	Fauna and Flora Pollution	Negative	High	Moderate	Minor
5	Avifauna Disturbance of threatened and wetland bird species	Negative	Moderate	Moderate	Minor
6	Fauna and Flora Expansion of alien species	Negative	Moderate	Moderate	Minor
7	Fauna and Flora Human wildlife conflict / behavioural change due to poor waste management	Negative	Moderate	Moderate	Minor
8	Water Ecology Alteration of the watershed of the Gidabo River and associated highly sensitive biodiversity areas.	Negative	Moderate	Moderate	Minor
OPERATIONAL					
1	Flora Re-vegetation of indigenous plant species in greenery areas	Positive	None required	Moderate	Moderate
2	Avifauna	Negative	Moderate	Moderate	Minor

Impact number	Receptor / Impact	Character	Ease of Mitigation	Pre-mitigation Rating	Post-mitigation Rating
	Disturbance and Electrocutions (by electrical transmission lines) of avian species				
3	Fauna and Flora Water quality deterioration / pollution of surrounding water resources	Negative	Moderate	Moderate	Minor
4	Fauna Attraction of wild animals by food wastes and due to increased contact with people	Negative	Moderate	Moderate	Minor
DECOMMISSIONING					
1	Flora Contamination of the ecosystem during replacement of machineries, removal of pipelines and associated infrastructures	Negative	Moderate	Minor	Negligible
2	Flora Abandonment of roads and rehabilitation of affected areas	Positive	None required	Minor	Minor

Table 9-12: Potential Impacts on Biodiversity at the Dilla RTC in the SNNP Region

Impact number	Receptor / Impact	Character	Ease of Mitigation	Pre-mitigation Rating	Post-mitigation Rating
CONSTRUCTION					
1	Flora Deforestation and vegetation clearing	Negative	Moderate	Moderate	Minor
2	Fauna and Flora Habitat destruction	Negative	Moderate	Moderate	Minor
3	Fauna and Flora Pollution	Negative	High	Moderate	Minor
4	Avifauna Disturbance of threatened and wetland bird species	Negative	Moderate	Moderate	Minor

Impact number	Receptor / Impact	Character	Ease of Mitigation	Pre-mitigation Rating	Post-mitigation Rating
5	Fauna and Flora Expansion of alien species	Negative	Moderate	Moderate	Minor
6	Fauna and Flora Human wildlife conflict / behavioural change due to poor waste management	Negative	Moderate	Moderate	Minor
7	Water Ecology Alteration of the watershed of the Chichu River and associated riverside forest.	Negative	Moderate	Moderate	Minor
OPERATIONAL					
1	Flora Re-vegetation of indigenous plant species in greenery areas and use of local community agro-forestry practices	Positive	None required	Moderate	Moderate
2	Fauna and Avifauna Disturbance of birds and primates (Vervet monkey and Guereza)	Negative	Moderate	Minor	Minor
3	Water Ecology Chichu River and other sources water quality deterioration and pollution	Negative	Moderate	Moderate	Minor
4	Fauna Attraction of wild animals by wastes	Negative	Moderate	Moderate	Minor
DECOMMISSIONING					
1	Flora Contamination of the ecosystem during replacement of machineries, removal of pipelines and associated infrastructures;	Negative	Moderate	Minor	Negligible
2	Flora	Positive	None required	Minor	Minor

Impact number	Receptor / Impact	Character	Ease of Mitigation	Pre-mitigation Rating	Post-mitigation Rating
	Abandonment of roads and rehabilitation of affected areas				

In both the Yirga Alem IAIP and Dilla RTC sites, effective implementation of the identified mitigation measures is expected to reduce the potential negative impacts to minor significance.

The impact assessment has concluded that the identified impacts can be effectively managed through the implementation of mitigation measures identified within the ESMP (refer to Chapter 11).

9.13 SOCIO-ECONOMIC IMPACTS

This section describes the potential impacts and consequences of interaction between the Project activities and receptors. Where significance of the impacts is assessed as moderate to major, mitigation measures, management and monitoring are proposed. The proposed mitigation and management measures will be implemented at the Yirga Alem IAIP and Dilla RTC sites and by their contractors.

The identified impacts include effects associated with in-migration. Rather than assessing in-migration separately, where in-migration is a contributing or driving factor for a particular impact, this is noted in the sections below.

To view the full report with regards to potential socio-economic impacts within the SNNP Region, refer to **Appendix C-12**.

9.13.1 EMPLOYMENT AND THE ECONOMY

The construction stage of the Project will generate new jobs/employment opportunities during construction, estimates on employment numbers were not provided within the Feasibility Report (current estimate of approximately 1300 employment opportunities) since the facility will be developed in a phased manner and therefore construction will happen concurrently with operation. The MACE Feasibility Report presented direct and indirect employment estimates, see **Table 9-13** for the first five years of the operational phase of the proposed project.

Table 9-13: Predicted Employment Numbers as a result of the operational phase IAIP and RTC in the SNNP Region

Employment Type	Year 1	Year 2	Year 3	Year 4	Year 5
Direct employment	**9257**	**22217**	**38016**	**56668**	**89516**
IAIP Total	3906	9287	15842	23571	37196
RTC and related activities	120	180	270	405	608
Farming sector	5231	12750	21904	32692	51712
Indirect Employment	**4628**	**11109**	**19008**	**28334**	**44758**

Source: MACE

In addition, the proposed facilities will require goods and services throughout their lifecycle. There are opportunities for local businesses to provide these goods and services (e.g. catering for the workers camp, office-related supply opportunities and services such as cleaning, etc.). As a result, existing local businesses may expand or new businesses may be established locally to meet these demands – providing further employment opportunities. This is referred to as indirect employment.

POTENTIAL IMPACT

The development will generate skilled and unskilled positions, with the number of unskilled positions dropping substantially after the construction period. Given that most working age local people are engaged in the agricultural farming activities, it is possible that the existing skills set among local people of working age would not always be a perfect match for the direct employment opportunities that will be created by the project.

Therefore, the developer should consider organising training to create new skill sets among local residents and also capitalising on some skills that are transferrable from the agricultural farming activities to the project in order to maximise local employment.

In terms of indirect employment, the realisation of opportunities will depend not only on the project, but also on the initiative and business abilities of local entrepreneurs. Given the potential of a much higher demand for new businesses in the region and the limited number of existing businesses, it is anticipated that the number of business development opportunities and/or indirect employment will be significant.

SIGNIFICANCE

The impacts on employment and economy that are likely to be triggered during the construction stages of the project would be **positive**, **direct**, **regional**, **long-term** and of **medium** severity. The probability of the impacts is considered to be **high** because the project is a significant and strategic development in the area. The significance of these positive impacts on employment and economy is therefore considered to be **major** and as a **major positive** impact does not need mitigation.

The operational impacts on economy and employment are also considered to be **positive**, **direct**, **regional**, **long-term** and of **low** to **medium** severity (as the number of new jobs generated by the project would tail off at the operation phase). The probability of the impacts occurring is considered to be **high**. The significance of the impacts is considered to be **moderate** and a moderate positive impact does not need mitigation.

For transparency purposes, the social impacts are presented within a significance rating table included in Appendix A of the Socio-economic report (refer to **Appendix C-12**).

9.13.2 LAND ACQUISITION AND IMPACT ON LIVELIHOODS

The ESIA team conducted site observations and consultations with the affected people prior to the construction stage of the SNNP IAIP Project. It is worth noting that although all land in Ethiopia belongs to the state, a number of individual farmers either officially (through a land rental agreement) or unofficially (often, a verbal or no agreement), still cultivate land and grow crops on the plots in the project area. The local authorities in SNNP started the resettlement process a year ago and it is highly likely that the local authorities followed the national resettlement process and not best international practice, because the national and federal legislation on land acquisition does not cover, for example assistance to vulnerable people, consultations and agreement whether it is better to compensate certain families in cash rather than in-kind/land, coordination of activities to ensure people do not loose harvest opportunities, etc.

Further impact and mitigation for the resettlement process will be provided in a separate resettlement action plan (RAP).

POTENTIAL IMPACT

The land acquisition process that involves physical displacement will have a long term irreversible negative impact on the agricultural activities of local farmers. Although such farmers could be compensated for the lost crops (and residential buildings), they often lose at least one or two harvests while looking for an alternative plot which is not guaranteed to be of the same quality and size. This situation could have a long term impact on the entire household’s livelihood and food security.

SIGNIFICANCE

The impacts on livelihood that are likely to be triggered during the construction and operation stages of the project would be **negative**, **direct**, **local**, **long-term** (15 years of concurrent construction and operation in total) and of **high** severity (even though the PAPs will be compensated and most are planning to acquire tenants' rights on an alternative/ new plot using the compensation received - it will take years of agricultural efforts to make sure that the alternative/new plot is at least of the same quality of soil and productivity as the "old" one which has been improved but "taken away" by the project). The probability of the impacts is considered to be **high** (the government already started the resettlement process a year ago – which to-date included surveying and valuation as well as early stages of the payment process). The significance of this negative impact on project affected people's (PAPs) livelihood is therefore considered to be **major negative** and will require mitigation. Provided that mitigation actions are implemented by the project implementation team according to the AfDB OS2 requirements (see the SNNP RAP for more information), the post-mitigation impact would be reduced to moderate.

Although the PAPs will receive compensation, further best international practice mitigation measures will be suggested in the SNNP RAP.

9.13.3 COMMUNITY HEALTH

Although an accurate number of total workers that will be employed during construction is currently unknown (current estimate of approximately 1300 employment opportunities), there will be potential for the workforce to introduce and/or increase the rate of spread of communicable diseases in the project area. This includes the introduction of a new disease and/or a more virulent strain of an existing disease.

However, the workforce is not the only factor that may contribute to the transmission of communicable diseases. The project is also likely to result in in-migration (from other parts of Ethiopia). Similar to the workforce, there is potential for in-migration to introduce and increase the rate of spread of communicable diseases in the Project area (including sexually transmitted diseases/STDs).

There are a number of diseases that are already prevalent in the project area, which is contributing to the current rates of morbidity and mortality. This includes malaria, typhoid (communicable disease) and influenza (communicable disease) which during the household survey in the project area have been identified as a key contributor in the local communities' rates of morbidity.

Similarly to the community health impacts during the construction stage, there is potential for the workforce to introduce and/or increase the rate of spread of communicable diseases in the project area during operation. This includes the introduction of a new disease and/or a more virulent strain of an existing disease.

The transmission of communicable diseases in the project area during construction and operation can be exacerbated by a number of factors. Health care facilities are limited in the project area. Therefore, the capacity (e.g. availability of diagnostic equipment, availability of medicine) to respond to an increase in the transmission of communicable diseases could be limited.

POTENTIAL IMPACTS

An increase in the transmission of communicable diseases may occur as the result of the introduction of workers into the area. In terms of communicable diseases and in addition to the existing prevalence of the malaria rates in the project area, of particular note and concern could be: tuberculosis and HIV/AIDS (mainly through drug abuse/blood transfusions/sexual relationship, etc.).

If left untreated communicable diseases can lead to long-term health issues and therefore the impact can be characterised as being long-term and in some instances permanent.

The existing local health care facilities have limited capacity to respond to an increase in the transmission of communicable diseases, potentially leaving the local residents vulnerable.

SIGNIFICANCE

The impact on community health that is likely to be triggered during the construction stage of the project would be **negative**, **direct**, **local**, **long-term** and of **low** severity (primarily due to low population density). The probability of the impacts is considered to be **medium**. The significance of this negative impact on community health is therefore considered to be moderate and requires mitigation.

The operational impact on community health is also considered to be negative, direct, local, long-term and of **low** severity (as the number of workers and associated in-migration would drop during the operation phase). The probability of the impacts occurring is considered to be **medium**. The significance of the impacts is considered to be **moderate** and requires mitigation.

9.13.4 COMMUNITY SAFETY AND SECURITY

There are a number of safety related issues that are likely to arise during the construction stage of the project. These include:

- Traffic accidents - the Project will increase the number of vehicles on the local road network through the transport of workers, goods, materials and machinery to and from the project site during construction. With an increase in vehicles, particularly heavy haulage vehicles, comes the increased potential for accidents and injuries to occur. Given the relatively low level of current road use, this is unlikely to occur. Instead, the key issue is likely to be the potential for an increase in accidents or incidents (particularly during construction), which can lead to injuries and/ or fatalities.
- The presence of new infrastructure. There are often safety issues with the establishment of new infrastructure – for example, community members interacting with unsecured equipment. This can lead to onsite accidents and injuries;
- The management of hazardous materials and waste. There are a number of Project activities that will generate hazardous waste or perishable waste that if not being properly managed, could contribute to spread of infectious and other diseases; and
- The Project will require security. Security personnel will be employed through Government contracts during construction and operation.

POTENTIAL IMPACTS

Impacts on community safety (e.g. possibility of accidents) and security (e.g. incidence of crime) can result from an increase in traffic and in-migration in the project area, the establishment of onsite infrastructure and the management of hazardous materials.

SIGNIFICANCE

The impact on community safety and security that is likely to be triggered during the construction stage of the project would be **negative**, **direct**, **local**, **long-term** and of **low** severity (primarily due to low population density). The probability of the impacts is considered to be **low mainly** due to robust management plans that will be implemented by the IPDC.

The operational impact on community health is also considered to be **negative**, **direct**, **local**, **long-term** and of **low** severity (as the number of workers and associated in-migration would drop during the operation phase). The probability of the impacts occurring is considered to be **low**.

Due to the existing management measures, the local extent and significance of the potential impact, the overall impact is assessed as **minor negative** during construction and operation and requires mitigation.

9.13.5 ENVIRONMENTAL EMISSIONS

The construction activities will generate:

- Noise, which can result from a variety of onsite civil works activities (e.g. construction of infrastructure, reversing sensors on large vehicles);
- Vibration, which may result from construction activities; and
- Dust, which can be generated through site grading, driving on dry, dusty and dirty roads. This can impact the surrounding air quality, disrupting the amenity value of an area and potentially impacting community health (e.g. further aggravating respiratory illnesses).
- The noise levels at receptors close to the site (within 500 m of the site boundary) will exceed the IFC residential day-time noise guideline. Any receptors beyond 500m are expected to be below the guideline. The construction activities will not occur at night.

During the operation activities the levels of noise and vibration are expected to reduce. Operational noise levels are expected to meet the residential guideline at all receptors beyond 200 m from the site.

POTENTIAL IMPACTS

In terms of noise, a detailed noise impact assessment has been completed and should be referred to. Increase in dust levels could generate impacts on local residents and the appropriate management measures will be put in place by subcontractors.

SIGNIFICANCE

The off-site construction noise impacts identified would be **negative**, **direct**, **local**, **short-term** and of **low** to **medium** severity. Given the variable nature of the construction activities and worst-case assumptions adopted, the probability of the impacts occurring is **medium** (i.e. there is a fair chance the impacts would be lower than predicted). The significance of the impacts is therefore considered to be **moderate**.

The off-site operational noise impacts identified would be **negative**, **direct**, **local**, and **long-term** in consideration of the baseline noise environment, the predicted levels are expected to be above the applicable guideline criteria, and the impact severity is therefore considered **medium**. Given the dependence on weather conditions and the worst-case assumptions adopted, the probability of the impacts occurring is **medium** (i.e. there is a fair chance the impacts would typically be lower than predicted). The significance of the impacts is therefore considered to be **moderate** and requires mitigation.

9.13.6 COMMUNITY INFRASTRUCTURE AND SERVICES

The construction period will be phased with operation commencing while construction continues, this is expected to last 15 years until all construction phases are completed entirely. The majority of construction workers will be from outside the area (as well as the influx associated with in-migration).

An increase in population in the wider SNNP Region (due to employment opportunities and in-migration during construction) is likely to place additional pressure on existing infrastructure and services (e.g. healthcare). This often results in a reduction in capacity of existing infrastructure and services to meet the needs of the local residents (as well as the additional population added by the Project); leading to diminished quality of services as well as reduced access to the existing infrastructure.

However, during construction the workforce will be accommodated at camps and it is assumed that sub-contractors will provide a range of on-site amenities inside the camps. This will, to some extent minimise the need for the workforce to use (or rely on) local infrastructure, i.e. minimising the pressure that may be experienced by community infrastructure and services. It is anticipated that at the conclusion of the construction phase, the workers brought in from outside the area will leave.

In terms of the operation phase, it is anticipated that new direct and indirect jobs will be generated by the operational activities. Given the duration of the project, it is anticipated that the operational workforce will relocate to the region, potentially bringing their families with them which could place some additional pressure on the local infrastructure. However given the nature of the project, it has the potential to attract new and private investments in improved infrastructure, and assuming that

some workers will be sourced from the local area, it is anticipated that this additional pressure can be accommodated.

POTENTIAL IMPACTS

During both the construction and operation phase, the project may place additional pressure on existing healthcare facilities, for instance, should a worker become sick or an incident on site resulting in an injury occur. However, there is limited capacity for the existing healthcare facilities to respond to this demand (due to the limited number of health care workers, number of existing hospitals and diagnostic equipment). For this reason, if healthcare is required, workers will likely need to use a medical point located within their workers' camp or other medical facilities located in the SNNP Region. A Community Health Management Plan will help reduce any pressure that may be placed on local health care facilities.

In terms of the construction phase, the road infrastructure may be affected by increased traffic, however, this impact is expected to be local in terms of the extent and occur over a short period of time. The above impacts may be greater depending on the degree of in-migration that occurs. This will need to be monitored closely – and the impact revisited if this becomes an issue.

SIGNIFICANCE

The potential strain on existing infrastructure (roads & infrastructure wear and tear, and reduced ability of local clinic to cope with the increased number of patients) would be **negative**, **direct**, **local**, **temporary** and of **medium** severity. Given the variable nature of the potential transportation activities (both timing-wise and with regards to precise identification of the roads that will be used most) and difficulty to predict the extent and the number of medical cases that would require medical facilities, worst-case assumptions were adopted. As such, the probability of the impacts occurring is **high**. The significance of the impacts is therefore considered to be **major** and requires mitigation.

The potential strain on existing infrastructure (congested and/or closed roads, infrastructure wear and tear, and reduced ability of local clinic to cope with the increased number of patients) would recede when the project moves into the operational stage and will be of medium severity, while the probability of the impacts occurring is **low**. The significance of the impacts is therefore considered to be **moderate** and requires mitigation.

9.13.7 SUMMARY OF SOCIO-ECONOMIC IMPACTS

A breakdown of potential construction phase and operational phase impacts and ratings are provided in **Table 9-14**. To view the full reports with regards to potential socio-economic impacts within the SNNP Region, refer to **Appendix C12**.

Table 9-14: Potential construction and operation risks associated with socio-economic activities

Impact number	Receptor	Character	Ease of Mitigation	Pre-mitigation Rating	Post-mitigation Rating
CONSTRUCTION					
1	**Employment and Economy** An increase in employment opportunities and demand for goods and services are positive. The Project will provide employment opportunities for the wider SNNP region.	Positive	Not Applicable	Major	Major

Impact number	Receptor	Character	Ease of Mitigation	Pre-mitigation Rating	Post-mitigation Rating
2	**Land Acquisition** Loss of access to agricultural land plots and in some cases, loss of residential buildings and other assets (crops). The impact is long-term because the effect will be long-lasting. The Project will impact local farmers, where some of them received compensation and moved on to other areas, but others have stayed because they did not want to lose their harvest - as they had no information when the site clearing activities will start.	Negative	Moderate	Major	Moderate
3	**Community Health** Potential for the workforce to introduce and/or increase the rate of spread of communicable diseases in the project area. The project is also likely to result in in-migration (from other parts of Ethiopia). Similar to the workforce, there is potential for in-migration to introduce and increase the rate of spread of communicable diseases in the Project area (including sexually transmitted diseases/STDs).	Negative	Moderate	Moderate	Moderate
4	**Community Safety and Security** Potential safety and security risks in the local area. The impact is long-term due to 15 year construction period. The impact is limited to local settlements. The impact likely occurs during the construction phase with the rare frequency.	Negative	Moderate	Minor	Negligible
5	**Environmental Emissions**	Negative	Moderate	Moderate	Minor

Impact number	Receptor	Character	Ease of Mitigation	Pre-mitigation Rating	Post-mitigation Rating
	Noise, which can result from a variety of onsite civil works activities (e.g. construction of infrastructure, reversing sensors on large vehicles); Vibration, which may result from construction activities; and dust, which can be generated through site grading, driving on dry, dusty and dirty roads. This can impact the surrounding air quality, disrupting the amenity value of an area and potentially impacting community health (e.g. further aggravating respiratory illnesses).				
6	**Community Infrastructure and Services** Potential strain, congestion, and wear and tear for roads and strain on medical facilities in the local area. The impact is limited to local settlements. Temporary impacts are expected at irregular intervals during the construction phase. This would happen due to workers influx.	Negative	High	Major	Moderate
OPERATIONAL					
1	**Employment and Economy** An increase in employment opportunities and demand for goods and services are positive. The impact is long-term because it occurs during the operation phase. The Project will provide employment opportunities for the wider SNNP region.	Positive	Not Applicable	Moderate	Moderate
2	**Livelihood/Sources of Income**	Negative	High	Major	Moderate

Impact number	Receptor	Character	Ease of Mitigation	Pre-mitigation Rating	Post-mitigation Rating
	Loss of access to agricultural land plots and in some cases, loss of residential buildings and other assets (crops). The impact is long-term because the effect will be long-lasting. The Project will impact local farmers, where some of them received compensation and moved on to other areas, but others have stayed because they did not want to lose their harvest - as they had no information when the site clearing activities will start.				
3	**Community Health** There is potential for the workforce to introduce and/or increase the rate of spread of communicable diseases in the project area during operation. This includes the introduction of a new disease and/or a more virulent strain of an existing disease. The impact is long-term because if diseases are untreated the impact could be long-lasting.	Negative	Low	Moderate	Minor
4	**Community Safety and Security** Potential safety and security risks in the local area. The impact is long-term due to 15 year construction/operation period. The impact is limited to local settlements. The impact likely occurs during the operational phase with rare frequency.	Negative	High	Minor	Minor
5	**Environmental Emissions** The impact is limited to local settlements. Short-term impacts with the rare frequency during the operation phase. During	Negative	Moderate	Moderate	Minor

Impact number	Receptor	Character	Ease of Mitigation	Pre-mitigation Rating	Post-mitigation Rating
	the operation activities the levels of noise and vibration are expected to reduce. Operational noise levels are expected to meet the residential guideline at all receptors beyond 200 m from the site.				
7	**Community Infrastructure and Services** Potential strain, congestion, and wear and tear for roads and strain on medical facilities in the local area. The impact is limited to local settlements. The transmission of communicable diseases in the project area during operation and strain on limited health and other facilities and infrastructure the existing capacity of the infrastructure to cope with more people in the area (i.e. new staff and their families attracted to the area by the IAIP operations).	Negative	Low	Moderate	Minor
DECOMMISSIONING					
1	**Employment** The impact is long-term because after decommissioning the permanent operation employment opportunities will be lost. The Project will provide employment opportunities for the wider SNNP region.	Negative	Low	Major	Moderate

Generally, in both the Yirga Alem IAIP and Dilla RTC sites, effective implementation of the identified mitigation measures is expected to reduce the potential negative impacts to moderate or minor significance.

The impact assessment has identified that the identified impacts can be effectively managed through the implementation of mitigation measures identified within the ESMP (refer to Chapter 11).

9.14 CULTURAL HERITAGE IMPACTS

Establishment of the proposed IAIP Project will result in the demolition of four identified churches as well as relocation of graves present within the IAIP footprint. The mitigation of these impacts on each of the churches to be affected are detailed within the ESMP, Chapter 11 of this ESIA.

An orthodox church is located in close proximity to the Dilla RTC site, as such activities associated with the RTC site may result in disturbances to the church due to its proximity. The mitigation of this impact is address in the ESMP contained within Chapter 11 of the ESIA.

A breakdown of potential construction phase and operational phase impacts and ratings are provided in **Table 9-14**. To view the full reports with regards to potential cultural heritage impacts within the SNNP Region, refer to **Appendix C13**.

Table 9-15: Potential construction and operation risks associated with cultural heritage

Impact number	Receptor	Character	Ease of Mitigation	Pre-mitigation Rating	Post-mitigation Rating
CONSTRUCTION					
1	Loss of cultural resources (four churches) at the IAIP	Negative	Moderate	Major	Minor
2	Loss of cultural resources (eight graves) at the IAIP	Negative	Moderate	Major	Minor
3	Disturbance during prayer days at Orthodox church by dust and noise.	Negative	Moderate	Moderate	Minor
OPERATIONAL					
1	Disturbance during prayer days at Orthodox church by dust and noise.	Negative	Moderate	Minor	Negligible
DECOMMISSIONING					
N/A					

Generally, in both the Yirga Alem IAIP and Dilla RTC sites, effective implementation of the identified mitigation measures is expected to reduce the potential negative impacts to minor or negligible significance. Consultation with the local community has concluded that the re-establishment, relocation and compensation for these heritage resources will be acceptable mitigation for the community. The impact assessment has identified that the identified impacts can be effectively managed through the implementation of mitigation measures identified within the ESMP (refer to Chapter 11).

10 CUMULATIVE IMPACTS

The ESIA investigates potential cumulative impacts that could occur as a result of the proposed development. This chapter includes physical, biological and social cumulative impacts associated with the proposed Project.

The information which is presented below is a consolidation of the identified impacts associated with the proposed SNNP IAIP and RTC. These impacts have been sourced from various specialist reports, refer to **Appendix C** for the full specialist reports. This chapter considers the cumulative effects that could arise from a combination of the SNNP IAIP and RTC project effects. In addition, consideration has been given to the project impacts in combination with those of other existing or planned developments in the surrounding area. The cumulative impact assessment includes consideration of other developments which might take place as a consequence of the project, e.g. to provide access, power or water supplies, sewage treatment or waste disposal, or to house or provide jobs for people attracted to the area by the project.

10.1 SOILS

The purpose of this section is to identify the likely project cumulative effects on soils. The description is based on primary data obtained from site investigations. **Table 10-1** summarises the impacts identified at both the SNNP IAIP and RTC sites as being significant in terms of soil, land use and land capability. To view the full report with regards to potential impacts on soils within the SNNP Region, refer to **Appendix C1.**

Table 10-1: **Potential Cumulative Impacts on Soils in the SNNP Region**

Impact number	Description of Impact	Stage	Ease of Mitigation	Pre-mitigation Rating	Post-mitigation Rating
1	Erosion Eroded areas will continue to spread, unless stopped, resulting in a cumulative negative effect on the site's identified soils resulting in large scale losses of valuable topsoil and erosion gullies forming.	Negative	Low	Major	Major
2	Sedimentation Eroded soil particles may end up in nearby watercourses, as sedimentation.	Negative	Low	Major	Major
3	Loss of topsoil Topsoil will be lost, however lost topsoil can be transferred to an alternative area to continue cultivation.	Negative	High	Moderate	Moderate
4	Compaction	Negative	Low	Moderate	Minor

Impact number	Description of Impact	Stage	Ease of Mitigation	Pre-mitigation Rating	Post-mitigation Rating
	Soil compaction results in the change of the original structure of the soils.				
5	Change in surface profile The surface profile of the sites will be changes to create a platform for the agri-industrial buildings and associated infrastructure.	Negative	Nil	Minor	Minor
6	Change in land use The land will undergo permanent changes as the land use will change from farming to an agri-industrial use.	Negative	Nil	Moderate	Moderate
7	Change in land capability The proposed development will permanently alter the lands capability of the affected areas.	Negative	Nil	Moderate	Moderate
8	Dust creation If bare surfaces and soil stockpiles are not watered and vegetated, there is a potential for high amounts of dust creation.	Negative	Moderate	Moderate	Minor
9	Soil Contamination Contamination may occur due to the large vehicles on site. This should be prevented, otherwise well-drained after contact with the pollutants, to decrease chances of contaminating water resources.	Negative	Low	Major	Minor

The most significant cumulative impacts relate to soil erosion and sedimentation, eroded areas will spread until measures are put in place to stop the erosion. Since erosion is a risk at these sites (the IAIP site in particular) and the sites are close to watercourses, sedimentation will also be a significant risk. As erosion will have a cumulative effect, so will sedimentation.

10.2 SURFACE WATER

This section of the report identifies the potential risks associated with the surface water at the proposed project site. There is no permanent flowing surface water resources on the sites. The Gidabo River runs to the west of the IAIP site and Chichu River runs to the north of the RTC site.

The IAIP site has significant areas of erosion along the western portion of the site, associated with drainage lines along the border of the site. Erosion channels run along the road, adjacent to the RTC site, which are associated with concentrated stormwater runoff. Increased hardstanding may result in increased volumes and velocities of water entering and flowing through these existing drainage channels and ultimately entering the nearby watercourses.

Table 10-2 below identifies the potential cumulative impacts on surface water and the significance of the impact. To view the full report with regards to potential impacts on surface water within the SNNP Region, refer to **Appendix C2.**

Table 10-2: Potential Cumulative Impacts on Surface Water in the SNNP Region

Impact number	Description of Impact	Stage	Ease of Mitigation	Pre-mitigation Rating	Post-mitigation Rating
1	Altering the hydrological regime of the nearby water sources and drainage lines.	Negative	Moderate	Moderate	Minor

The primary cumulative impact of concern relates to the potential for negative impacts to occur on the Gidabo River and drainage lines. The primary mitigation measures to implement in order to minimise this impact include keeping hard standing areas to a minimum. The implementation of the requirement set within Article 5(15) of the Industrial Parks Council of Ministers Regulation No 417/2017 will ensure that 25% of each of the development plots within the IAIP remain undeveloped. For the remaining 75% of the site that is developed the Enterprises should be required to make use of permeable paving. All pavements and car parks in communal areas are to be built with the use of permeable paving. Finally, where surface water exits on the site, energy dissipators should be incorporated in order to ensure erosion does not occur as a result of the concentrated runoff.

10.3 GROUND WATER

Based on primary data obtained, it was identified that the local communities in and around the IAIP site rely heavily on groundwater as their source of water, with groundwater forming the bulk of their water supply. Four boreholes fitted with hand pumps were identified throughout the area, however; only one of these were operational at the time of the investigation. Two operational water supply boreholes were identified around the site, one equipped with a hand pump, located approximately 250m to the east of the northern portion of the IAIP site, and one equipped with a solar pump approximately 500m west of the southern portion of the IAIP site. The solar pump discharges water to a central collection point approximately 120m south of the borehole. Furthermore a perennial spring was identified approximately 650m to the west of the SNNP project site, adjacent to the Gidabo River. The recharge area for this spring could potentially be within the SNNP IAIP project site.

There are a number of deep water supply boreholes located around Dilla. One of these boreholes is located within the SNNP RTC site boundary with the second located just outside the north-eastern boundary of the site. No information was found on these boreholes. A spring was identified approximately 900m to the west of the SNNP RTC site boundary. The spring is used as a source of domestic water supply by local community members.

Activities undertaken associated with the development of the Project and other activities resulting from the development could result in an increased risk of contamination of the groundwater resources. The potential cumulative impacts on the groundwater is presented in the **Table 10-3** below. To view the full report with regards to potential impacts on ground water within the SNNP Region, refer to **Appendix C3.**

Table 10-3: Potential Cumulative Impacts on Ground Water in the SNNP Region

Impact number	Description of Impact	Stage	Ease of Mitigation	Pre-mitigation Rating	Post-mitigation Rating
1	Contamination of groundwater resources from contaminated surface water runoff or subsurface leakages from underground chemical storage and/or effluent systems	Negative	Low	Moderate	Minor

In order to minimise this impact, the IPDC is to contain and treat surface water runoff in order to prevent it entering the groundwater environment. The IPDC must continually monitor groundwater quality in the vicinity of the site in order to quickly identify if contamination has occurred. Based on the findings of the impact assessment, it is concluded that the development and operation of the SNNP IAIP and RTC will have a minor impact on the receiving groundwater environment should the implementation of the proposed mitigation measures be undertaken effectively.

10.4 WETLANDS

This section identifies the likely project cumulative effects in relation to wetland environments in the Project area. Section 8.8 provides a detailed description of the Wetlands associated with IAIP site. The RTC site showed no signs of wetland habitat within its boundary.

According to Dixon and Wood (2003) wetlands in Ethiopia are often perceived as impediments to development and progress or as productive lands suitable for agriculture. The Ethiopian government encouraged farmers to cultivate wetlands to compensate for more drought-induced food shortages. The Rural Agricultural Development Department also developed its own programmes for draining some larger wetlands for agriculture (Wood, 2000). In southwest Ethiopia, for example, the area of wetlands converted to agricultural land increased from 28% in 2003 to 66% in 2006 (Legesse, 2007). Similarly, a number of microfinance initiative groups were established in several towns to cultivate peri-urban wetlands and produce bricks from wetland material. Consequently, several wetlands in Ethiopia, either disappeared or are on the verge of drying out (Shewaye, 2008), while others rapidly decline in water quality (Mereta *et al.*, 2012).

In addition, the wetlands have been considered as wastelands and seen as nuisance to human development (Dixon and Wood 2003; Bezabih and Mosissa 2017). This view has led to considerable conversion of wetlands, which has usually been seen as a progressive public-spirited endeavour believed to enhance the health and welfare of society, alleviate flooding, improve sanitation and land reclamation. Moreover, the underlying causes of wetland loss are that they are assumed to be less important than other priorities or tend to be regarded as free goods (Bezabih and Mosissa 2017).

This continued conversion or degradation of individual wetland systems has resulted in a cumulative loss of wetland habitat at the landscape level within Ethiopia. The majority of the cumulative hydrological impacts manifest downstream due to altered stream flow processes, e.g. the loss of a wetland upstream which provided a function of streamflow regulation will result in water input into a downstream system containing higher volumes and velocity and therefore a higher erosive force. This will result in the erosion and potential loss of the downstream wetland, which then potentially will result in the wetland system further downstream being impacted and so forth (Johnston, 1994).

As the systems identified within the IAIP site are small isolated systems which have already been significantly impacted, are minimal in size and currently provide minimal goods and services; the cumulative impacts are deemed to be minimal relating to this development, especially considering that artificial systems are proposed within the proposed layout. These artificial systems may be managed to ensure the ecological state of the systems are maintained as near-natural as possible, resulting in improved goods and services.

Table 10-4 summarises the cumulative impacts identified as being significant in terms of wetlands. To view the full report with regards to potential impacts on wetlands within the SNNP Region, refer to **Appendix C4.**

Table 10-4: Potential Cumulative Impacts on Wetlands in the SNNP Region

Impact number	Description of Impact	Stage	Ease of Mitigation	Pre-mitigation Rating	Post-mitigation Rating
1	Wetlands within greater landscape Decrease in average area of individual wetlands	Negative	High	Moderate	Negligible
2	Wetlands within greater landscape Change in proportion of wetland types	Negative	High	Moderate	Negligible
3	Wetlands within greater landscape Shift in spatial configuration of wetlands	Negative	Moderate	Moderate	Minor
4	Wetlands within greater landscape Change in cumulative wetland function	Positive	High	Negligible	Moderate

As indicated above the negative cumulative impacts relate to the decrease in average area, change in proportion and shift in spatial configuration of wetlands within the greater Project area. In order to minimise these impacts mitigation measures are recommended to be implemented by the IPDC. These include the creation of waterbodies within the site to offset the loss of the isolated depressions. These would be artificial isolated systems providing islands of aquatic habitat. There are provisions made for open waterbodies within the landscape plan, which would be able to provide similar services as the current waterbodies are providing. This is under the assumption that the waterbodies in the plan will be designed as far as possible to represent 'natural' systems. It is important that the correct species be utilised when constructing these waterbodies and that an operational maintenance plan is developed to ensure these waterbodies are maintained in a state that will continue to provide isolated habitat for aquatic-dependent species. The plan must include the control and maintenance of sediment and nutrient input into these systems to prevent sedimentation and potential eutrophication.

The through-flow or circulation of water is also important to ensure water doesn't stagnate. The use of certain species such as *Typha* and *Cyperus* species must be managed to ensure they do not form dense communities throughout the waterbody resulting in a homogenous community (low biodiversity) and limited to no open water areas (decreasing habitat diversity). The maintenance of these systems will result in micro-hotspots of biodiversity that has the potential of supporting a variety of floral and faunal species. As such, implementation of the proposed mitigation measures may result in a positive cumulative impact in terms of wetlands in the greater landscape.

10.5 AIR QUALITY

The cumulative impacts of air quality include the residents living near the IAIP and RTC sites being affected by a change in particulate and gaseous concentrations in the greater project area. **Table 10-5** below highlights the cumulative impacts of air quality. To view the full report with regards to potential impacts on air quality within the SNNP Region, refer to **Appendix C5**.

Table 10-5: The Potential Cumulative Impacts on Air Quality in the SNNP Region

Impact number	Description	Character	Ease of Mitigation	Pre-mitigation Rating	Post-mitigation Rating
1	Increased particulate and gaseous concentrations Residential receptors within immediate vicinity of site boundary	Negative	Moderate	Moderate	Minor
2	Increased particulate and gaseous concentrations Residential receptors beyond site boundary	Negative	Moderate	Minor	Negligible

The cumulative interactions of the air quality impacts are deemed to be of moderate significance for receptors located within the immediate vicinity of the site boundary, however with mitigation this can be reduced to a minor significance. With mitigation the receptors beyond the site boundary will experience a negligible cumulative impact.

Proposed mitigation measures have been identified in the ESMP. Refer to Chapter 11 for the full ESMP to be applied at the SNNP IAIP and RTC.

10.6 NOISE

The current noise climate is typically rural, with very limited anthropogenic influences, therefore noise levels are anticipated to increase substantially within the area with the introduction of the SNNP IAIP, based on the fact that there is a lack of noise prior to the development of the proposed project.

Table 10-6 below identifies the potential cumulative impacts of noise levels which may be caused by the proposed project, as well as the severity of the impacts. To view the full report with regards to potential impacts on noise levels within the SNNP Region, refer to **Appendix C7**.

Table 10-6: Potential Cumulative Impacts of Noise in the SNNP Region

CUMULATIVE					
1	Degradation of noise climate / annoyance Residential receptors within 200m of the site boundary	Negative	Moderate	Moderate	Minor
2	Degradation of noise climate / annoyance Residential receptors beyond 200m of the site boundary	Negative	Moderate	Minor	Negligible

The cumulative interactions of the noise impacts are deemed to be of moderate significance for receptors located within the immediate vicinity of the site boundary, however with mitigation this can be reduced to a minor significance. With mitigation the receptors beyond the site boundary will experience a negligible cumulative impact.

Proposed mitigation measures have been identified in the ESMP. Refer to Chapter 11 for the full ESMP to be applied at the SNNP IAIP and RTC.

10.7 TRANSPORT AND ACCESS

There are no known large-scale planned developments in the vicinity of this development, therefore no cumulative transport impacts are expected on the local road network

To view the full Traffic and transport report with regards to potential impacts within the SNNP Region, refer to **Appendix C.8**.

10.8 WASTE MANAGEMENT

The Yirga Alem and Dilla towns lack formally organised and advanced waste management systems such as collection, transport and disposal; therefore identifying the risks associated with waste management is necessary. The table below highlights the cumulative impacts of the proposed project, by taking into account the current waste management programs at the IAIP site and RTC site. To view the full Waste Management Plan (WMP) with regards to potential cumulative impacts on biodiversity within the SNNP Region, refer to **Appendix C9**.

Table 10-7: Potential Cumulative Impacts Associated with Waste Management in the SNNP Region

Impact number	Description of Impact	Stage	Ease of Mitigation	Pre-mitigation Rating	Post-mitigation Rating
1	Residual wastes and industrial hazardous waste and bio-medical wastes are the only wastes that will cumulate outside the IAIP and RTC. The remainder of the waste streams will be prevented, reused or recovered.	Negative	Low	Major	Moderate

No hazardous wastes shall be permitted to be disposed of outside the boundary of the IAIP or RTC unless being transported to a sanitary landfill. The IPDC must place the responsibility of safe disposal of hazardous waste on the generator. It will be the generators responsibility to ensure that the waste collector which will be transporting the waste for disposal has obtained a permit from the Urban Administration to do so in terms of Article 4(1) of the 'Solid Waste Management Proclamation 513/2007'. In addition, the Generator will need to provide evidence in writing from the receiving disposal site of its capacity to recycle or dispose of the waste in an environmentally sound manner (Article 6(3)). Proof of safe disposal should be provided to the IPDC, such as a waste disposal ticket issued and date stamped by the sanitary landfill. This waste stream is anticipated to be small, limited to cleaning materials and small quantities of bio-medical waste since most of the processing to be undertaken on site is for the food industry and therefore hazardous process materials should be limited.

10.9 VISUAL

The potential visual impacts were assessed during the scoping phase and identified as requiring a visual impact assessment as visual impacts will occur as a result of the proposed IAIP development.

Table 10-9 below identifies the potential cumulative visual impacts which may be caused by the proposed project, as well as the severity of the impacts. To view the full report with regards to potential visual impacts within the SNNP Region, refer to **Appendix C10**.

Table 10-8: Potential Cumulative Impacts Associated with Visual Impact Assessment in the SNNP Region

Impact number	Description of Impact	Stage	Ease of Mitigation	Pre-mitigation Rating	Post-mitigation Rating
1	There is no existing construction activities taking place in the area, should additional activities occur, the development will have a cumulative negative impact on the areas directly surrounding the site and to the east on the ridge. The impacts will be related to dust and noise and will be temporary in nature.	Negative	Moderate	Minor	Negligible
2	During the operational stage additional developments will be in keeping with the industrial warehouses of the IAIP and will be marginally noticeable as urban creep. The increased development will add to the overall development and modernisation of the area.	Positive	N/A	Minor	Minor

The cumulative impacts identified related to the dust and noise nuisance impacts being compounded with additional developments occurring in the area. This impact is easily mitigated and with mitigation the significance is negligible. There is no existing or proposed development in the region of the IAIP that has been identified, however; once operational it is anticipated that further development in the area will take place to provide supporting services to the IAIP. The additional developments will be in keeping with the industrial warehouses of the IAIP and will be marginally noticeable as urban creep. The increased development will add to the overall development and modernisation of the area. To view the full report with regards to potential cumulative impacts on the visibility of the site within the SNNP Region, refer to **Appendix C10**.

10.10 BIODIVERSITY

The existing biodiversity components and associated key features which include typical flora and fauna, protected areas and non-protected sensitive resources that are found inside and within the vicinity of the project sites were identified in order to assess the potential impacts on the biodiversity of the IAIP and RTC site associated with the proposed project. The baseline conditions within the survey area have been determined through desk-based reviews of available information, field surveys and consultations with concerned authorities. To view the full report with regards to potential cumulative impacts on biodiversity within the SNNP Region, refer to **Appendix C11**.

Table 10-9 below indicates how the biodiversity within the Yirga Alem IAIP and Dilla RTC may be impacted by the proposed development, respectively.

Table 10-9: Potential Cumulative Impacts on Biodiversity in the SNNP Yirga Alem IAIP

Impact number	Description of Impact	Stage	Ease of Mitigation	Pre-mitigation Rating	Post-mitigation Rating
1	Biodiversity / Ecosystem Maintenance Erosion and top soil removal during excavation	Negative	Moderate	Minor	Negligible
2	Biodiversity / Ecosystem Maintenance Contamination of the ecosystem due to spill over and dusting of some construction materials and wastes	Negative	Moderate	Minor	Negligible
3	Biodiversity / Ecosystem Maintenance Alteration of the watershed of the area	Negative	Moderate	Moderate	Minor

Table 10-10 below indicates how the biodiversity within the Dilla RTC region may be impacted by the proposed development.

Table 10-10: Potential Cumulative Impacts on Biodiversity in the SNNP Dilla RTC

Impact number	Description of Impact	Stage	Ease of Mitigation	Pre-mitigation Rating	Post-mitigation Rating
1	Biodiversity / Ecosystem Maintenance Erosion and top soil removal during excavation	Negative	Moderate	Minor	Negligible
2	Biodiversity / Ecosystem Maintenance Alteration of the watershed of the area	Negative	Moderate	Moderate	Minor
3	Biodiversity / Ecosystem Maintenance Increased urbanization leading to increased pressure on the ecosystem	Negative	Moderate	Moderate	Minor

The cumulative interactions of the biodiversity impacts are deemed to be of moderate to minor significance, however with mitigation these can be reduced to minor or negligible significance.

Proposed mitigation measures have been identified in the ESMP (refer to Chapter 11).

10.11 SOCIO-ECONOMIC

Development of the proposed project has the potential to result in significant socio-economic impacts. The table below provides a summary of the anticipated cumulative impacts to the Social Study Area due to the presence of the Project.

To view the full report with regards to potential impacts on socio-economics within the SNNP Region, refer to **Appendix C12**.

Table 10-11: Potential Cumulative Impacts on the Socio-Economic Sector in the SNNP Region

Impact number	Description of Impact	Stage	Ease of Mitigation	Pre-mitigation Rating	Post-mitigation Rating
1	Influx of people Pressure on existing infrastructure within IAIP and RTC sites, in particular medical facilities/water supply/sanitation and education facilities.	Negative	Moderate	Major	Minor
2	Resettlement and Land Acquisition Resettlement and land acquisition displacing farmers, their agricultural activities including crops and other assets	Negative	Moderate	Major	Minor
3	Increase in Employment An increase of employment and diversity of employment will benefit the next generation by generating alternative revenue streams	Positive	Not Applicable	Major	Major
4	Gross Domestic Product The combined impact on the economy of the regional IAIP site and the RTC sites will help diversify the Gross Domestic Product of Ethiopia from being primarily dependent on agriculture. The potential is great that these projects combined will uplift the economy.	Positive	Not Applicable	Major	Major

The cumulative interactions of the socio-economic impacts are deemed to be of minor negative significance, with mitigation measures implemented, as well as major positive impacts in terms of employment and the economy.

Proposed mitigation measures have been identified in the ESMP (refer to Chapter 11).

10.12 CULTURAL HERITAGE

There are no known cultural heritage resources of significance in the vicinity of this development, therefore no cumulative heritage impacts are expected. To view the full cultural and heritage report with regards to potential impacts within the SNNP Region, refer to **Appendix C13**.

10.13 CUMULATIVE IMPACTS SUMMARY

CUMULATIVE EFFECT OF COMBINED PROJECT IMPACTS

Cumulative impacts are generated as a result of a number of project effects interacting as well as where an effect is not mitigated and continues causing increasing impacts. While some impacts may be insignificant by themselves, cumulative impacts accumulate over time, from one or more sources and can result in the degradation of important resources. Not all impacts will result in cumulative impacts, however those that have been identified and are predicted to potentially occur have been listed below in **Table 10-12**.

A cumulative interactions table illustrates how an impact on one variable can affect another and how severe the cumulative impact is. To read the table, follow the y-axis from the top to the bottom of the table, and see how severe the cumulative interactions are anticipated to be.

Table 10-12: Cumulative Interactions between Multiple Potential Impacts for the IAIP and RTC

	Soils	Surface water	Ground water	Wetlands	Air quality	Noise	Waste management	Biodiversity	Socio-economic
Socio-economic	Minor	Minor	Minor	Negligible	Minor	Minor	Moderate	Minor	
Biodiversity	Negligible	Negligible	Negligible	Minor	Negligible	Negligible	Minor		Minor
Waste management	Major	Minor	Minor	Negligible	Minor	Negligible		Minor	Moderate
Noise	Negligible	Negligible	Negligible	Negligible	Negligible		Negligible	Negligible	Minor
Air quality	Minor	Negligible	Negligible	Negligible		Negligible	Minor	Negligible	Minor
Wetlands	Negligible	Minor	Minor		Negligible	Negligible	Negligible	Minor	Negligible
Ground water	Negligible	Minor		Minor	Negligible	Negligible	Minor	Negligible	Minor
Surface water	Low		Minor	Minor	Negligible	Negligible	Minor	Negligible	Minor
Soils		Major	Negligible	Negligible	Minor	Negligible	MInor	Negligible	Minor

CONSIDERATION OF CUMULATIVE IMPACTS WITH OTHER DEVELOPMENTS

It is also important for the ESIA to analyse the proposed projects in light of the surrounding land uses and proposed developments. The Yirga Alem IAIP is located a short distance away from the urban edge of Aposto Town while the Dilla RTC is located on a plot of land situated on the edge of Dilla Town.

Currently the land use taking place on the sites is predominantly agricultural, where people living in the local vicinity are engaged in the production of the major crops grown in the area, and residential with dispersed dwellings located on the sites.

The information provided by the IPDC with respect to Yirga Alem Town's Master Plan, does not indicate any known proposed developments in the area of the IAIP site however it is noted that the site is closer to Aposto and no Master Plans were made available for the town to assess.

There will be associated infrastructure requirements such as roads, power lines and sanitation services infrastructure required as a result of the IAIP and RTC developments. All of these infrastructure projects will have a limited footprint for which mitigation of impacts can be simply achieved. Where applicable these associated infrastructure projects will be subject to an Environmental Impact Assessment which will need to consider the IAIP and the impacts captured herein.

The proposed IAIP will generate a new large population that will place significant pressure on some of the existing insufficient infrastructure in the area such as healthcare facilities, schools etc. and therefore the Park will incorporate community facilities such as a clinic, schools and churches to alleviate these pressures. The existing population will be able to utilise these. This will have a beneficial cumulative effect on the existing communities living close to the IAIP.

There are residential dwellings located around both sites and therefore dust and noise control measures will need to be closely monitored and the ESMP implemented fully in order to manage the potential cumulative impacts. The grievance mechanism for the community must be well implemented and tracked to ensure any issues are dealt with in a timely manner.

11 ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN (ESMP)

11.1 INTRODUCTION AND OBJECTIVES

This chapter presents the Environmental and Social Management Plan (ESMP) which is aimed to prevent, minimise or mitigate potential adverse environmental and social impacts, and enhance the Project's beneficial impacts throughout the design, construction and operational phases.

The purpose of the ESMP is to ensure that environmental and social impacts and risks identified during the ESIA process are effectively managed during the implementation of the proposed Project. This ESMP has been prepared to identify the environmental and social management and mitigation actions required to address any potential adverse impacts, enhance the Project's beneficial impacts, and monitoring requirements to ensure the implementation of the project is undertaken in accordance with the requirements of the AfDB and applicable national legislation and regulations of the FDRE.

The objectives of this ESMP are therefore to:

- Set out an action plan of environmental and social management measures to be implemented that aim to achieve the avoidance, minimisation or mitigation (including offset or compensation) of adverse environmental and social impacts and enhance positive impacts of the project;
- Define specific actions to be taken, responsibilities for these actions, timeframes for implementation; associated budget;
- Identify monitoring requirements in relation to positive and negative effects, environmental performance, and compliance with statutory environmental and social regulations requirements that are to be undertaken to ensure compliance or continued improvement throughout the specified periods; and
- Outline consultative requirements and training / capacity building requirements deemed necessary for effective implementation of the plan.

The ESMP is to be implemented and monitored by the SNNP IPDC as the project's implementing entity and will form the basis of site-specific management plans that will be prepared by the contractors and sub-contractors as part of their construction methodology prior to works commencing.

The ESMP forms an integral part of an ESIA. It is considered a dynamic instrument as its management actions may be subject to change as a result of feedback received during project implementation and/or in response to unexpected impacts or impacts with a magnitude different to that predicted in the ESIA. Monitoring will provide the information for periodic review and subsequent alteration of the ESMP as necessary. This will ensure that undesirable impacts are detected early and remedied effectively.

Best practice principles require that every reasonable effort is made to reduce and preferably to prevent negative impacts while enhancing the benefits. These principles have guided the ESIA process. In many cases, potential negative impacts have been avoided through careful design. The ESIA involved concurrent and ongoing data collection and public consultation activities to date.

Since an ESMP continues to evolve in scope and depth with subsequent stages of the Project preparation and implementation, the ESMP of this ESIA provides a first outline. Detailed stand-alone sub-plans may be developed to specify ESMP issues in its further progress, such as detailed Monitoring Plans, Emergency Response Plans, and Community Development Plans.

Annual monitoring reports shall be compiled and made available to the relevant authorities and relevant financial lenders. The reports shall cover the status of environmental and social, including health and safety related aspects like permits, status of compliance with obligations arising from such permits / licences, exceedances of regulatory environmental standards with root cause analyses and details of corrective measures implemented.

11.2 SUMMARY OF IMPACTS

Chapter 9 of the ESIA identifies the potential impacts, both positive and negative, associated with the proposed Project. **Table 11-1** summarises the identified potential impacts and the associated post-mitigation significance rating for the various phases of the Project.

Table 11-1: Summary of impacts and post mitigation significance

Environment	No.	Impact	Character	Ease of Mitigation	Post-mitigation Rating		
					Construction	Operation	Decommission
Soils	1	Erosion	Negative	Low	Moderate	Moderate	Moderate
	2	Sedimentation	Negative	Low	Moderate	Minor	Minor
	3	Loss of topsoil	Negative	High	Negligible	Negligible	Negligible
	4	Compaction	Negative	Moderate	Moderate	Major	Negligible
	5	Change in surface profile	Negative	Nil	Major	Negligible	Negligible
	6	Change in land use	Negative	Nil	Major	Negligible	Negligible
	7	Change in land capability	Negative	Nil	Major	Negligible	Negligible
	8	Dust creation	Negative	Moderate	Minor	Minor	Minor
	9	Soil Contamination	Negative	Moderate	Minor	Minor	Minor
Surface Water	1	Hydro-carbon contamination from the earth-moving machinery and vehicles	Negative	Moderate	Minor	Negligible	Minor
	2	Sedimentation of the Gidabo River and drainage lines	Negative	Moderate	Minor	Negligible	Minor
	3	Altering the hydrological regime Change in runoff volume	Negative	Moderate	Negligible	Minor	Negligible
	4	Altering the hydrological regime Change in runoff velocity	Negative	High	Negligible	Minor	Negligible
Ground Water	1	Lowering of groundwater levels	Negative	Moderate	Negligible	Minor	Negligible
	2	Contamination of groundwater resources from contaminated surface water runoff or subsurface leakages from underground chemical storage and/or effluent systems	Negative	Moderate	Negligible	Minor	Negligible
	3	Loss of recharge area for the springs through reduction of permeable surface	Negative	None	Negligible	Minor	Negligible
Wetlands	1	Direct loss/ degradation of natural wetland habitat & biota	Negative	Low	Major	Major	Negligible
	2	Hydrological functioning/regime modifications	Negative	Low	Moderate	Minor	Moderate
	3	Erosion and Sedimentation	Negative	Moderate	Minor	Minor	Minor
	4	Water Quality	Negative	Moderate	Minor	Minor	Negligible

Environment	No.	Impact	Character	Ease of Mitigation	Post-mitigation Rating Construction	Post-mitigation Rating Operation	Post-mitigation Rating Decommission
Air Quality	1	Increased particulate and gaseous concentrations within immediate vicinity of site boundary	Negative	Moderate	Minor	Minor	Minor
	2	Increased particulate and gaseous concentrations on surrounding receptors	Negative	Moderate	Negligible	Negligible	Negligible
Noise	1	Degradation of noise climate / annoyance Within 500m from the site boundary	Negative	Moderate	Moderate	Minor	Moderate
	2	Degradation of noise climate / annoyance Beyond 500m from the site boundary	Negative	Moderate	Minor	Negligible	Minor
Transport and Access	1	Impact on safety of the community in the area due to increased vehicle volumes	Negative	Low	Minor	Minor	Minor
Waste Management	1	Public Nuisance - Inappropriate disposal of construction waste	Negative	High	Minor	Negligible	Minor
	2	Hazardous waste materials being stockpiled on bare ground presenting a potential for contamination of soils, surface and ground water.	Negative	High	Minor	Minor	Minor
	3	Domestic waste generated by construction staff	Negative	High	Minor	Negligible	Minor
	4	Overfull waste bins littering streets and blockage of drainage channels	Negative	High	Negligible	Minor	Negligible
	5	Any wastes being ultimately disposed of at a landfill will contribute the volumes of waste and hence the lifespan of the landfill.	Negative	High	Negligible	Minor	Negligible
	6	Disposal to unlined landfill impacting surface and groundwater resources.	Negative	High	Negligible	Minor	Negligible
Visual	1	Construction equipment and dust	Negative	Low	Minor	Negligible	Negligible
	2	Site Clearing	Negative	Low	Negligible	Negligible	Negligible
	3	Physical impact on landforms	Negative	Low	Negligible	Negligible	Negligible
	4	Intrusion on the sense of place and scenic landscape	Negative	Low	Negligible	Moderate	Negligible
	5	Light Pollution	Negative	Low	Negligible	Minor	Negligible

Environment	No.	Impact	Character	Ease of Mitigation	Post-mitigation Rating Construction	Operation	Decommission
	6	Roads and /or road widening	Negative	Low	Negligible	Negligible	Negligible
Biodiversity (Yirga Alem IAIP)	1	Deforestation and vegetation clearing	Negative	Moderate	Minor	Negligible	Negligible
	2	Habitat destruction,	Negative	Moderate	Minor	Negligible	Negligible
	3	Road kills	Negative	Moderate	Minor	Negligible	Negligible
	4	Pollution	Negative	High	Minor	Negligible	Negligible
	5	Disturbance of threatened and wetland bird species	Negative	Moderate	Minor	Negligible	Negligible
	6	Expansion of alien species	Negative	Moderate	Minor	Negligible	Negligible
	7	Human wildlife conflict / behavioural change due to poor waste management	Negative	Moderate	Minor	Minor	Negligible
	8	Alteration of the watershed of the Gidabo River and associated highly sensitive biodiversity areas.	Negative	Moderate	Minor	Negligible	Negligible
	9	Re-vegetation of indigenous plant species in greenery areas	Positive	None Required	-	Moderate	-
	10	Disturbance and Electrocutions of avian species	Negative	Moderate	-	Minor	-
	11	Water quality deterioration / pollution of surrounding water resources	Negative	Moderate	Negligible	Minor	Negligible
	12	Contamination of the ecosystem during replacement of machineries, removal of pipelines and associated infrastructures;	Negative	Moderate	-	-	Negligible
	13	Abandonment of roads and rehabilitation of affected areas	Positive	None Required	-	-	Minor
Biodiversity (Dilla RTC)	1	Deforestation and vegetation clearing	Negative	Moderate	Minor	Negligible	Negligible
	2	Habitat destruction,	Negative	Moderate	Minor	Negligible	Negligible
	3	Pollution	Negative	High	Minor	Negligible	Negligible
	4	Disturbance of threatened and wetland bird species	Negative	Moderate	Minor	-	-
	5	Expansion of alien species	Negative	Moderate	Minor	-	-
	6	Human wildlife conflict / behavioural change due to poor waste management	Negative	Moderate	Minor	Minor	-
	7	Alteration of the watershed of the Chichu River and associated riverside forest.	Negative	Moderate	Minor	Negligible	-

Environment	No.	Impact	Character	Ease of Mitigation	Post-mitigation Rating		
					Construction	Operation	Decommission
	8	Re-vegetation of indigenous plant species in greenery areas and use of local community agro-forestry practices	Positive	None Required	-	Moderate	-
	9	Disturbance of birds and primates (Vervet monkey and Guereza)	Negative	Moderate	-	Minor	-
	10	Chichu River and other sources water quality deterioration and pollution	Negative	Moderate	Negligible	Minor	Negligible
	11	Contamination of the ecosystem during replacement of machineries, removal of pipelines and associated infrastructures;	Negative	Moderate	-	-	Negligible
	12	Abandonment of roads and rehabilitation of affected areas	Positive	None Required	-	-	Minor
Socio-Economic	1	Employment and Economy An increase in employment opportunities and demand for goods and services	Positive	Not Applicable	Major	Moderate	Moderate
	2	Land Acquisition / Resettlement / Livelihood Loss of access to agricultural land plots and in some cases, loss of residential buildings and other assets (crops).	Negative	Low	Moderate	Moderate	Negligible
	3	Community Health Potential for the workforce to introduce and/or increase the rate of spread of communicable diseases in the project area.	Negative	Moderate	Moderate	Minor	Negligible
	4	Community Safety and Security Potential safety and security risks in the local area.	Negative	High	Negligible	Negligible	Negligible
	5	Environmental Emissions Nuisance from noise; vibrations and dust.	Negative	Moderate	Minor	Minor	Negligible
	6	Pressure on Community Infrastructure and Services Strain, congestion, and wear and tear for roads and strain on medical facilities in the local area.	Negative	Low	Moderate	Minor	Negligible

The **non-implementation** of the project will impede development and delay the industrialisation of the agricultural industry in the SNNP Region.

11.3 MITIGATION AND ENHANCEMENT MEASURES

The ESIA stipulates the environmental standards to be adhered to by the parties involved in the various phases of the project life cycle. As such the ESMP comprises of a section for each of the following project life cycle phases:

- Planning and design;
- Construction;
- Operation; and
- Decommissioning.

11.3.1 PLANNING AND DESIGN PHASE

The planning and design phase of the project is not expected to have any direct impacts on the environment. Consequently no management control measures are required and/or proposed.

Various layout options were considered to minimise the environmental impacts and the currently proposed layout plan has been chosen on the basis of these considerations.

11.3.2 CONSTRUCTION PHASE

The proposed mitigation measures for the construction phase are detailed in **Table 11-2.**

11.3.3 OPERATION PHASE

The proposed mitigation measures for the operation phase are detailed in **Table 11-3**.

11.3.4 DECOMISSIONING PHASE

As the project is considered to be a permanent facility, detailed Decommissioning activities have not been included. Consequently no management control measures are required and/or proposed at this stage. These are to be identified prior to decommissioning, should such activities be required in the future.

Table 11-2: Construction Phase Environmental and Social Management Plan

Environment	No.	Potential Impacts	Proposed Mitigation and Benefit Enhancement Measures	Institutional Responsibility for Implementation	Timeframe / Due Date	Cost Estimates	Monitoring	Applicable Safeguards / Documents
Soils	S1	Erosion Eroded areas will continue to spread, unless stopped, resulting in a cumulative effect on the site's identified soils	Soil protection strategies: (i) Placement of soil stockpiles so as to prevent exposure to wind and water erosion. (ii) Access and haul roads should have gradients or surface treatment to limit erosion, and road drainage systems should be provided. (iii) Terracing, slope reduction, runoff velocity limitation and the installation of appropriate drainage; should be incorporated into the site management plan to limit soil erosion. (iv) Reduce negative impacts to the site and surroundings by controlling erosion and sedimentation. (v) Soil erosion control measures shall conform to the best management practices highlighted in the appropriate code. (vi) Regular inspections will be undertaken to assess erosion and sediment migration from topsoil stockpiles. Where unacceptable rates of erosion are identified, remedial works will be undertaken, or the stockpile will be relocated. (vii) The size and area of stockpiles of soil will be minimised. Stockpiles that may be susceptible to erosion must be terraced, covered or have suitable erosion control measures such as silt fences. (viii) Soil stockpiles should be revegetated to protect the soils against erosion	IPDC / Contractor	During site clearing and throughout construction	Covered in Project Budget	See Monitoring Plan Ref. 11.4.3(2)	AFDB OS1 IFC (World Bank) EHS Guidelines for Mining, 2007 Development Corporation Regulations (SNNP), 2017
	S2	Sedimentation Eroded soil particles may end up in a nearby watercourse, which runs through the IAIP site, as sedimentation	Sedimentation control management measures: (i) Reduce and prevent off-site sediment transport by using measures such as settlement ponds and silt fences. (ii) The implementation of soil erosion mitigation measures will also mitigate against enhanced sedimentation.	IPDC / Contractor	During site clearing and throughout construction	Covered in Project Budget	See Monitoring Plan Ref.11.4.3(1)	AFDB OS1 World Bank Group EHS Guidelines Development Corporation Regulations (SNNP), 2017
	S3	Loss of topsoil Topsoil will be lost, however lost topsoil can be transferred to an alternative area to continue cultivation; there is limited topsoil at the IAIP site	Topsoil management measures: (i) Topsoil stripped should be stockpiled for rehabilitation. (ii) Irrespective of where topsoil is stockpiled, it should be kept moist and vegetated as soon as possible. (iii) Topsoil stockpiles should be kept low (between 3 and 5 meters tall). It is recommended that the top 50cm of soil be stripped, where possible according to the guidelines below; - Demarcate the area to be stripped clearly, so that the contractor does not strip beyond the demarcated boundary. - The top 50cm of the entire area should be stripped, where the soils are deep enough, and relocated by truck along set removal paths. - The area to be stripped requires storm water management; the in-flow of water should be prevented with suitable structures. - Prepare the haul routes prior to stripping.	IPDC / Contractor	During site clearing and throughout construction	Covered in Project Budget	See Monitoring Plan Ref.11.4.3(1)	AFDB OS1 World Bank Group EHS Guidelines Development Corporation Regulations (SNNP), 2017

Environment	No.	Potential Impacts	Proposed Mitigation and Benefit Enhancement Measures	Institutional Responsibility for Implementation	Timeframe / Due Date	Cost Estimates	Monitoring	Applicable Safeguards / Documents
			- Stripping should not begin in wet conditions. (iv) Within each stripping unit, segments should be stripped progressively, ensuring that the dump truck used to move the soils does not drive over the area to be stripped, but rather behind it on the basal layer, in order to avoid compaction and degradation of the topsoil properties (Humphries Rowell Associates, 2000). (v) When stockpiled soils are to be used elsewhere, the soil fertility should be assessed to determine the level of fertilisation required to sustain normal plant growth. The fertility remediation requirements need to be verified at the time of rehabilitation. The topsoil should be uniformly spread onto the rehabilitated areas and care should be taken to minimise compaction that would result in soil loss and poor root penetration (Viljoen and Associates, 2012). (vi) The MoEFCC generally requires that maximum stockpile heights for material management or resource recovery activities be in the range of 3 to 5 metres. These stockpile height limits are largely based on stockpile manageability, dust impacts, stability, potential impacts to underlying infrastructure and fire risk. The height of stockpiles should generally be lower than surrounding structures. Greater stockpile heights will need careful and adequate assessment of all the additional risks the increased height poses and it must be demonstrated that these risks can be managed, as excess height can also lead to other safety risks such as instability. (vii) Fertile topsoil is to be stockpiled before construction, for future reuse or donation. The term 'fertile' is not defined here, so in the case of the SNNP sites' topsoil, it would depend on the need for this soil elsewhere. The topsoil at the site had been successfully used to grow crops in previous years. (viii) Topsoil within the top 25cm should be carefully extracted and secured. Please note that the IFC (2007) guidelines refer to the top 50cm being topsoil but the Industrial Parks Development Corporation Document should be adhered-to in this case as it is site-specific. Based on the soils identified at the sites, the deeper topsoil's are closer to 25cm in depth than 50cm and some are extremely shallow. (ix) Topsoil mounds of 1-2m high are recommended. Please note that the IFC (2007) guidelines specify stockpiles of 3-5m high, but, again, as the Industrial Parks Development Corporation Document is site specific, it should be adhered-to. (x) Stockpiled topsoil must be revegetated to protect against erosion, discourage weeds and maintain active soil microbes.					
	S4	Compaction Soil compaction results in the change of the original structure	Compaction management measures: (i) Pre-defined, essential road routes should be clearly demarcated and adhered-to on site to restrict soil compaction to certain areas. (ii) Vehicles should not drive on soil when it is wet to avoid further soil compaction. Having said this, once soil is well-compacted, little further damage or rehabilitation can be done.	IPDC / Contractor	During site clearing and throughout construction	Covered in Project Budget	See Monitoring Plan Ref.11.4.3(1)	AFDB OS1 World Bank Group EHS Guidelines Development Corporation Regulations (SNNP), 2017

Environment	No.	Potential Impacts	Proposed Mitigation and Benefit Enhancement Measures	Institutional Responsibility for Implementation	Timeframe / Due Date	Cost Estimates	Monitoring	Applicable Safeguards / Documents
			(iii) Soils must not be stripped when they are wet as this can lead to compaction and loss of structure.					
	S7	Dust creation If bare surfaces and soil stockpiles are not watered and vegetated, there will be high amounts of dust creation	Dust suppression management measures: (i) When stockpiling soil one runs the risk of producing dust. The advised longer-term solution to this problem is to vegetate the soil as plant roots bind soil and protect the soil against the wind. Good vegetation coverage is necessary for this to be successful. (ii) As a shorter-term solution – for the period between stockpiling and plant growth – keeping the stockpiles damp will mitigate against the risk of dust creation. (iii) The MoEFCC generally requires that maximum stockpile heights for material management or resource recovery activities be in the range of 3 to 5 metres. These stockpile height limits are largely based on stockpile manageability, dust impacts. (iv) Stockpiled soils should be located in areas where trees can act as buffers to prevent dust pollution.	IPDC / Contractor	During site clearing and throughout construction		See Monitoring Plan Ref.11.4.3(1)	AFDB OS1 World Bank Group EHS Guidelines Development Corporation Regulations (SNNP), 2017
	S8	Soil Contamination Contamination occurs due to the large vehicles on site; this should be prevented otherwise well-drained after contact with the pollutants to decrease chances of contaminating water resources	Contamination management measures (i) On-site vehicles should be well-maintained, (ii) Drip trays should be placed under vehicles. (iii) On-site pollutants should be contained in a bunded area and on an impermeable surface. (iv) One should identify potentially toxic overburden and screen with a suitable material to prevent mobilisation of toxins. (v) Maintain control of substances entering the site, (vi) Provide adequate disposal facilities. (vii) Enforce a non-polluting environment.	IPDC / Contractor	Throughout construction	Covered in Project Budget	See Monitoring Plan Ref. 11.4.3(1) and 11.4.3(8)	AFDB OS1, OS4 World Bank Group EHS Guidelines Development Corporation Regulations (SNNP), 2017
Surface Water	SW1	Hydro-carbon contamination of the Gidabo river and other water resources	Contamination management measures: (i) Maintenance of on-site vehicles; (ii) Placement of drip trays under vehicles and relevant equipment when stationary; (iii) Fuel, lubricant and waste oil storage, dispensing and operating facilities must be designed and operated in a way to prevent contamination of water.	IPDC / Contractor	Throughout construction	Covered in Project Budget	See Monitoring Plan Ref. 11.4.3(3)	AFDB OS1, OS4 World Bank Group EHS Guidelines Development Corporation Regulations (SNNP), 2017
	SW2	Sedimentation of the Gidabo river and other water resources	Sedimentation management measures: (i) Appropriate placement and terracing of soil stockpiles, (ii) Appropriate drainage to be in place before construction takes place; (iii) Minimise the movement of heavy machinery around the areas that are prone to erosion; (iv) Construct during the dry season in close proximity to the river and other surface water features.	IPDC / Contractor	Throughout construction	Covered in Project Budget	See Monitoring Plan Ref. 11.4.3(3)	AFDB OS1 World Bank Group EHS Guidelines Development Corporation Regulations (SNNP), 2017
Wetland	W1	Direct loss/ degradation of natural wetland habitat & biota	(i) No mitigation possible as the wetland habitats are completely removed.	IPDC / Contractor	Throughout construction	Covered in Project Budget	See Monitoring Plan Ref. 11.4.3(1)	AFDB OS1, OS4 World Bank Group EHS Guidelines Development Corporation

Environment	No.	Potential Impacts	Proposed Mitigation and Benefit Enhancement Measures	Institutional Responsibility for Implementation	Timeframe / Due Date	Cost Estimates	Monitoring	Applicable Safeguards / Documents
								Regulations (SNNP), 2017
	W2	Hydrological functioning/regime modifications	(i) No mitigation possible as the wetland habitats are completely removed.	IPDC / Contractor	Throughout construction	Covered in Project Budget	See Monitoring Plan Ref. 11.4.3(1)	AFDB OS1, OS4 World Bank Group EHS Guidelines Development Corporation Regulations (SNNP), 2017
	W3	Erosion and Sedimentation (Receptors: W3; R1)	(i) These systems (Receptors W3 and R1) are located on the boundary and continue outside the boundary of the IAIP. No contaminated runoff must be allowed to enter these systems during construction. A construction stormwater management plan must be compiled and approved by relevant authority to ensure all surface onsite during construction is managed in the most environmentally friendly manner. (ii) The use of energy dissipaters at all stormwater discharge points needs to be implemented during both construction and operational phases. All stormwater outlet structures must be located outside of the identified systems with some allowance for outlet protection e.g. reno-mattresses or rock packs). (iii) Ideally construction in these area should occur during the dry season.	IPDC / Contractor	Throughout construction	Covered in Project Budget	See Monitoring Plan Ref. 11.4.3(1)	AFDB OS1, OS4 World Bank Group EHS Guidelines Development Corporation Regulations (SNNP), 2017
	W4	Water Quality (Receptors: W3; R1)	(i) These systems (Receptors W3 and R1) are located on the boundary and continue outside the boundary of the IAIP. No contaminated runoff must be allowed to enter these systems. (ii) No dumping of construction waste must occur within these systems.	IPDC / Contractor	Throughout construction	Covered in Project Budget	See Monitoring Plan Ref. 11.4.3(1)	AFDB OS1, OS4 World Bank Group EHS Guidelines Development Corporation Regulations (SNNP), 2017
Air Quality	AQ1 & AQ2	Air quality impacts Increased particulate and gaseous concentrations affecting residential receptors within immediate vicinity of site boundary and receptors beyond site boundary	(i) Apply methods to control open dust sources at construction sites, these include wet suppression and wind speed reduction measures as a source of water and material for wind barriers tend to be readily available. General control methods for open dust sources, as recommended by the USEPA, 1995) See **Annexure 11.1** for general control methods	IPDC / Contractor	Throughout construction phase	Covered in Project Budget	See Monitoring Plan Ref. 11.4.3(4)	AFDB OS1, OS4 USEPA, 1995 World Bank Group EHS Guidelines Development Corporation Regulations (SNNP), 2017
Noise	N1	Noise impacts Degradation of noise climate / annoyance on residential receptors within and beyond 200m of the site boundary	Management and technical options: (i) Plan construction activities in consultation with local communities so that activities with the greatest potential to generate noise are planned during periods of the day that will result in least disturbance. Information regarding construction activities should be provided to all local communities. Such information includes: - Proposed working times; - Anticipated duration of activities; - Explanations on activities to take place and reasons for activities;	IPDC / Contractor	Throughout construction	Covered in Project Budget	See Monitoring Plan Ref. 11.4.3(5)	AFDB OS1, OS4 World Bank Group EHS Guidelines Development Corporation Regulations (SNNP), 2017

Environment	No.	Potential Impacts	Proposed Mitigation and Benefit Enhancement Measures	Institutional Responsibility for Implementation	Timeframe / Due Date	Cost Estimates	Monitoring	Applicable Safeguards / Documents
			- Contact details of a responsible person on site should complaints arise. (ii) When working near a potential sensitive receptor, limit the number of simultaneous activities to a minimum as far as possible; (iii) Using noise control devices, such as temporary noise barriers and deflectors for high impact activities, and exhaust muffling devices for combustion engines when working in close proximity to sensitive receptors; (iv) Selecting equipment with the lowest possible sound power levels as practically possible; (v) Ensuring equipment is well-maintained to avoid additional noise generation; (vi) Provide and ensure the use of ear protection equipment for personnel working onsite in close proximity to noise sources; (vii) Ensure that noise emanating from machinery, vehicles and noisy construction activities (e.g. excavation, blasting) are kept at a minimum for safety, health and protection of workers in the vicinity of high noise levels and nearby communities; and (viii) Noise levels reaching the communities from blasting activities (if applicable) shall not exceed 90 dB(A). (ix) Advise community on the grievance mechanism and grievance submission procedure.					
Transport and Access	T1	Increased vehicle/vehicle & vehicle/NMT accident risks on the local road network	(i) It is recommended that due to the anticipated higher traffic volumes to and from the IAIP during operation, a typical access configuration of at least one of the accesses should include the following: - Access with 2 lanes In and 2 lanes Out; - Main road with short (80 m) right-turn In lane; - Main road with short (80 m) left-turn In lane; - Additional road signage & markings along the main road at all the accesses; and - Street lighting along the main road along the full length of the property frontage. Note, the configuration must be approved by the Ethiopian Roads Authority. It is recommended that additional pedestrian accesses be provided to the IAIP from the north and west of the site. These upgrades should be implemented for the construction phase to ensure safe access to all construction vehicles, and the future operation phase traffic.	IPDC / Contractor	Throughout construction	FDRE to determine – outside of project budget	See Monitoring Plan Ref. 11.4.3(1)	AFDB OS1 World Bank Group EHS Guidelines Development Corporation Regulations (SNNP), 2017
Waste Management	WM1 WM2 WM3	Construction waste Hazardous waste Domestic waste	(i) Provide segregated waste receptacles within the construction camp. (ii) Provide dedicated bins for hazardous waste, located on hardstanding within the construction camp. (iii) Ensure waste receptacles are easily available. (iv) Operate a clean site policy.	IPDC / Contractor	Throughout construction	Covered in Project Budget	See Monitoring Plan Ref. 11.4.3(6)	AFDB OS1. OS4 World Bank Group EHS Guidelines Development Corporation

Environment	No.	Potential Impacts	Proposed Mitigation and Benefit Enhancement Measures	Institutional Responsibility for Implementation	Timeframe / Due Date	Cost Estimates	Monitoring	Applicable Safeguards / Documents
			(v) All construction staff must be educated in waste management procedures. (vi) All staff must be responsible to keeping all food and packaging waste on them to be disposed of at the waste bins within the construction camp. (vii) Sufficient temporary ablution facilities must be provided for staff so they do not relieve themselves in the fields.					Regulations (SNNP), 2017 Waste Management Plan (Appendix 9.9 of ESIA)
Biodiversity (Yirga Alem IAIP)	B1 B2 B3 B4 B5 B6 B7 B8	Deforestation and vegetation clearing Habitat destruction Road kills Pollution Disturbance of threatened & wetland bird species Expansion of alien species Human wildlife conflict / behavioural change due to poor waste management Alteration of the watershed of the Gidabo River and associated highly sensitive biodiversity areas.	The following mitigation measures are to be implemented. (i) Avoiding damage to and loss of large mature trees and minimize vegetation clearance as much as possible; (ii) Rehabilitating and re-vegetating the areas affected during construction process; (iii) Ensure that considerable awareness is created and local knowledge is used where possible to determine key habitats that require consideration; (iv) Minimize numbers of temporary camps and sites chosen for all camps will be in permitted areas only; (v) Give special consideration to key habitats and their connectivity; (vi) Undertake regular monitoring of the main habitats; (vii) Establishing speed bumpers and precaution sign posts on the sensitive wild animal crossing points; (viii) Launching awareness creation programs for the construction staff; (ix) Developing effective management of waste and hazardous materials; (x) All fine earth materials must be enclosed during transportation to the site to prevent spillage and dusting; (xi) Spilled earth and construction material on the main roads should be cleaned up regularly; (xii) Trucks used during construction should be fitted with tailgates that close properly and with tarpaulins to cover the materials; (xiii) The transportation of lubricants and fuel to the construction site should only be done in the appropriate vehicles and containers; (xiv) All machinery must be keenly observed not to leak oils on the ground and (xv) Maintenance must be operated/carried out in a designated area (protected service bays) and where oils are completely restrained from reaching the ground; (xvi) Give special consideration to key habitats of threatened and wetland birds, (xvii) Local knowledge is used where possible to determine locally sensitive areas that require consideration; (xviii) Avoiding disturbance of nesting sites of threatened avian species; (xix) Use of birds friendly power lines and associated infrastructures; (xx) Develop effective management of hazardous materials;	IPDC / Contractor Ministry of Environment, Forest and Climate Change (MEFCC), SNNP Regional Environmental Agency and at woreda level	During site clearing and throughout construction	Covered in Project Budget	See Monitoring Plan Ref. 11.4.3(7)	AFDB OS1, OS3 World Bank Group EHS Guidelines Development Corporation Regulations (SNNP), 2017

Environment	No.	Potential Impacts	Proposed Mitigation and Benefit Enhancement Measures	Institutional Responsibility for Implementation	Timeframe / Due Date	Cost Estimates	Monitoring	Applicable Safeguards / Documents
			(xxi) Avoiding introduction of materials from areas where alien species occur and make sure that there are no new succession of exotic ones; (xxii) Undertake local monitoring on habitat change/prevalence of invasive species; (xxiii) Identification of approved disposal site and a system for supervision and monitoring; (xxiv) Avoiding feeding and any contact with wild animals. (xxv) Undertake regular monitoring of prevalence of human-wildlife conflict / behavioural change; (xxvi) Consult concerned stakeholders and develop human-wildlife conflict resolution systems; (xxvii) Special consideration will be given to water resources and sensitive biodiversity areas; (xxviii)Avoiding creation of access to steep slopes that would scar the landscape or lead to soil erosion; (xxix) Developing effective watershed management plan for Gidabo River and its surroundings; (xxx) Avoiding creation of transport access to sensitive landscapes; (xxxi) Use of biological soil and water conservation mechanisms.					
Biodiversity (Dilla RTC)	B1 B2 B3 B4	Deforestation and vegetation clearing Habitat destruction Pollution Disturbance of threatened & wetland bird species Expansion of alien species Human wildlife conflict / behavioural change due to poor waste management Alteration of the watershed of the Chichu River and associated riverside forest.	The following mitigation measures are to be implemented. (i) Give special consideration to key habitats of threatened and wetland birds, (ii) Undertake regular monitoring of locally sensitive areas that require consideration; (iii) Avoiding disturbance of nesting sites of threatened avian species; (iv) Use of birds friendly power lines and associated infrastructures; (v) Develop effective management of hazardous materials. (vi) Avoiding introduction of materials from areas where alien species occur and make sure that there are no new succession of exotic ones; (vii) Undertake local monitoring on habitat change/prevalence of invasive species; (viii) Launching awareness creation programs for the construction staff; (ix) Identification of approved disposal site and a system for supervision and monitoring; (x) Avoiding feeding and any contact with wild animals. (xi) Undertake regular monitoring of prevalence of human-wildlife conflict/behavioural change ; (xii) Consult concerned stakeholders and develop human- wildlife conflict resolution systems. (xiii) Special consideration will be given to water resources and sensitive biodiversity areas;	IPDC / Contractor Ministry of Environment, Forest and Climate Change (MEFCC), SNNP Regional Environmental Agency and at woreda level	During site clearing and throughout construction	Covered in Project Budget	See Monitoring Plan Ref. 11.4.3(7)	AFDB OS1, OS3 World Bank Group EHS Guidelines Development Corporation Regulations (SNNP), 2017

Environment	No.	Potential Impacts	Proposed Mitigation and Benefit Enhancement Measures	Institutional Responsibility for Implementation	Timeframe / Due Date	Cost Estimates	Monitoring	Applicable Safeguards / Documents
			(xiv) Avoiding creation of access to the riverine area that would scar the landscape or lead to soil erosion or devegetation; (xv) Developing effective watershed management plan for Chichu River and its surroundings; (xvi) Avoiding any drainage towards the River.					
Socio-Economic	SE1	Employment and Economy	(i) IPDC, through its website, is to inform local businesses of contracting opportunities in a timely manner; (ii) The IPDC is to maintain and regularly update a separate web page on the developer website dedicated to local tenders for the provision of goods and services. Such webpage should be widely publicised by the developer. (iii) The IPDC is to develop a Community Relations/CSR Policy, detailing contributions to local employment, training of young local specialists and any other community-benefit initiatives. (iv) The IPDC is to ensure that contractors are aware of the grievance mechanism and grievance submittal process. (v) IPDC is to create and populate a database of all suitable local service providers, prior to construction, to encourage more opportunities for local businesses. (vi) A Worker Influx Management Plan will need to be prepared to define labour practices in line with international standards that will need to be applied by the Contractors and their subcontractors, as well as in the Project's supply chain. The Worker Influx Management Plan will need to be aligned with the developer's Grievance Mechanism to ensure that the procedure is consistently implemented across all Project activities.	IPDC / Contractor	Prior to construction and throughout construction	Covered in Project Budget	See Monitoring Plan Ref. 11.4.3(9)	AFDB OS1, OS5 World Bank Group EHS Guidelines Development Corporation Regulations (SNNP), 2017
	SE2	Impact on Livelihoods through Land Acquisition	(i) Land acquisition and any displacement impacts on the project will be carried out in compliance with Ethiopian law and AfDB Operational Safeguard 2- Involuntary Resettlement (OS2). (ii) The MoI and the IPDC will seek to avoid physical displacement where possible, and to minimise economic displacement. (iii) Impacts on land and livelihoods shall be compensated. (iv) Any affected standing crops will be compensated at current market value to make sure that farmers to do lose harvest; (v) The affected Orphan land, i.e. the remaining portion of the land plot that remains with the farmer but made uneconomic and/or too small to use, will be compensated in full; (vi) Affected people will have access to an IPD, with the possibility for aggrieved individuals to resort to a second tier of independent review of the grievance. (vii) Vulnerable people will be identified and specifically assisted as needed. (viii) Stakeholder Engagement Plan (SEP) implementation with regards to keeping a regular dialogue with local communities, and in particular, with affected people. (ix) The IPDC/PIU need to follow the Resettlement Action Plan and monitor internally and externally the resettlement and land acquisition progress to ensure compliance the AfDB OS2 and National policies.	IPDC / PIU	Immediate	TBD	See Monitoring Plan Ref:	AfDB OS2

Environment	No.	Potential Impacts	Proposed Mitigation and Benefit Enhancement Measures	Institutional Responsibility for Implementation	Timeframe / Due Date	Cost Estimates	Monitoring	Applicable Safeguards / Documents
	SE3	Community Health	(i) A Community Health and Safety Plan will need to be prepared which addresses potential health risks to local residents. The plan will need to cover the following elements: - To minimise the impact, a number of steps can be taken – most of the measures largely include reducing the interaction between the workforce and local residents. It is assumed that the project will use dedicated workers camp to accommodate its workforce during construction. This will help to reduce the interaction between workers and local communities. - Implementation of Construction Environmental Management Plan (CEMP) procedures and schedule, as well as Environmental Monitoring Plan (Air Emissions, Dust) to see how air quality data is changing. - Early notification of local authorities on critical or exceptionally busy construction periods and air-polluting/dust- and noise-generating activities. - Dust suppression by water spraying, or other suitable means, in dry seasons, particularly in the areas close to sensitive residential and community receptors. (ii) As part of the induction process for new employees and workers, the Contractors are to provide training for all workers on the transmission routes and common symptoms of communicable diseases. This training will be supported by an ongoing awareness campaign (posters located in common areas within the camp). These measures can help reduce the potential for workers to unknowingly transmit communicable diseases. (iii) The workers camp is to include an internal first-aid ward and medical staff being present at the camp which to some extent will help to minimise the interaction between the workforce (particularly temporary construction workers) and local residents. (iv) The Community Health Management Plan is to be developed covering details on a Workforce Code of Conduct including code specific measures that target anti-social behaviour. (v) Contractors' are to comply with national HSE legislation and the UNDP HSE Policies. (vi) The project implementation team is to carry out regular audits of the HSE Management system implementation by Contractors. (vii) Implementation of the Health and Safety Management Policy and Worker Influx Management Plan. (viii) Provide the Project HSE Policies and Worker Influx Management Policies to all contractors and subcontractors during formal induction, including security contractors (if applicable). (ix) One "umbrella" Project Grievance Mechanism, is to be developed and accessible to all workers, including those who directly work for the IAIPs development and also employed by contractors. (x) The IPDC will ensure that Contractors will provide onsite first-aid tents (one tent per site) to ensure that basic medical attention and first aid treatment can be provided by a trained first-aider during the hours that the work is being undertaken at the Project site. For all medical incidents that require medical attention, the	IPDC / Contractor	Throughout construction	Covered in Project Budget	See Monitoring Plan Ref. 11.4.3(9)	AFDB OS1, OS5 World Bank Group EHS Guidelines Development Corporation Regulations (SNNP), 2017

Environment	No.	Potential Impacts	Proposed Mitigation and Benefit Enhancement Measures	Institutional Responsibility for Implementation	Timeframe / Due Date	Cost Estimates	Monitoring	Applicable Safeguards / Documents
			contractors will quickly provide transportation to the Workers' Camp clinic which will also help reduce the potential pressure on local healthcare facilities.					
	SE4	Community Safety and Security	(i) The project site is to be fenced, while any activities outside the main footprint are to be appropriately signposted. This will help ensure that accidents associated with new infrastructure will be minimised. (ii) Traffic Management Plans which will need to be prepared by Contractors during the construction phase will further minimise the potential risk of accidents, injuries and near misses. (iii) Provide the project HSE and Worker Management Plans to all subcontractors during formal induction, including the security contractors (if applicable). (iv) A Project Code of Conduct and appropriate training for security personnel are to be developed and implemented to ensure best practice in running a secure site and implementing the Code of Conduct that fosters behaviours that helps to avoid, eliminate or minimise the use of excessive force in potential conflict situations. (v) The project Health, Safety and Security Management Plan is to be provided to, and implemented by, all Contractors and subcontractors. (vi) The project Health and Safety Management Policy is to include details of a 'no tolerance to drugs and alcohol policy', as well as details on HIV/AIDS prevention, etc. (vii) Stakeholder Engagement Plan (SEP) is to be developed and implemented with regards to keeping a regular dialogue with local communities. (viii) One "umbrella" Project Grievance Mechanism, is to be developed and accessible to all workers, including those who directly work for the IAIPs development and also employed by contractors, as well as the community.	IPDC / Contractor	Throughout construction	Covered in Project Budget	See Monitoring Plan Ref. 11.4.3(9)	AFDB OS1, OS5 World Bank Group EHS Guidelines Development Corporation Regulations (SNNP), 2017
	SE5	Environmental Emissions	Refer to Air Quality Section of ESMP.					
	SE6	Community Infrastructure and Services	(i) The Workers Camp is to provide in-house laundry, first-aid, cooking, recreational, religious and common area facilities/rooms which will help to reduce the need for workers to use local infrastructure and services; (ii) The planned Workers Camp is to follow best practice guidance on workers' accommodation. (iii) Implement a community health management plan in consultation with relevant stakeholders (e.g. local doctors and the local authorities). This plan will ensure that appropriate and adequate health care services are provided on site and at the accommodation camp to address/ manage worker illnesses and injuries.	IPDC / Contractor	Throughout construction	Covered in Project Budget	See Monitoring Plan Ref. 11.4.3(9)	AFDB OS1, OS5 World Bank Group EHS Guidelines Development Corporation Regulations (SNNP), 2017
Cultural Heritage (Yirga Alem IAIP)	CH1 CH2	Loss of cultural resources (four churches) at the IAIP	The following mitigation measures are to be implemented during the Project development. (i) In consultation with the community choose church sites outside of the IAIP boundary, (ii) Developer pay compensation to the land owners of the sites	IPDC / Contractor	Prior to construction and throughout construction	Covered in Project Budget	See Monitoring Plan Ref. 11.4.3(9)	AFDB OS1, OS5 World Bank Group EHS Guidelines Development Corporation

Environment	No.	Potential Impacts	Proposed Mitigation and Benefit Enhancement Measures	Institutional Responsibility for Implementation	Timeframe / Due Date	Cost Estimates	Monitoring	Applicable Safeguards / Documents
			(iii) Developer construct temporary churches on the chosen site, (iv) Developer carefully transport the property of the church to the temporary churches of the new sites and construct new churches on the new sites. (v) Prior to the construction of the IAIP at the Yirga Alem site the graves/tombs have to be removed from the site and the bodies from these graves have to be buried outside of the IAIP on a site that will be agreed by the community and based on the norms and practices of the church. (vi) Prior to the construction of the IAIP at the Yirga Alem Site Compensation is to be paid to the family for reburial and land to be provided by the government for reburial.					Regulations (SNNP), 2017
	CH1 CH2	Loss of cultural resources (graves) at the IAIP	The following mitigation measures are to be implemented during the Project development. (i) The tombs has to be removed from the site and the bodies from these tombs has to be buried on a site agreed by the community; (ii) Compensation is to be paid to the family for reburial and land to be provided by the government for reburial.					
Cultural Heritage (Dilla RTC)	CH1	Disturbance during prayer days at Orthodox church by dust and noise at the RTC	The following mitigation measures are to be implemented during the Project development. (i) Mitigation measures as per air quality and noise impacts to be implemented; (ii) Construction activities to be minimised / stopped during religious holidays.	IPDC / Contractor	Prior to construction and throughout construction	Covered in Project Budget	See Monitoring Plan Ref. 11.4.3(4)	AFDB OS1, OS5 World Bank Group EHS Guidelines Development Corporation Regulations (SNNP), 2017

Table 11-3: Operation Phase Environmental and Social Management Plan

Environment	No.	Potential Impacts	Proposed Mitigation and Benefit Enhancement Measures	Institutional Responsibility For Implementation	Timeframe / Due Date	Cost Estimates	Comments / Further Action & Monitoring	Applicable Safeguards / Documents
Soils	S1	Erosion Eroded areas will continue to spread, unless stopped, resulting in a cumulative effect on the site's identified soils	(i) Regular inspection will be undertaken of all discharge points from site for early detection of erosion areas; remedial works will be undertaken accordingly; (ii) Soil erosion control measures shall conform to the best management practices highlighted in the appropriate code.	IPDC	Throughout Operation	Covered in Project Budget	See Monitoring Plan Ref. 11.4.4(1)	World Bank Group EHS Guidelines Development Corporation Regulations (SNNP), 2017
	S2	Sedimentation Eroded soil particles may end up in a nearby watercourse, which runs through the IAIP site, as sedimentation	Sedimentation control management measures: (i) Reduce and prevent off-site sediment transport by using measures such as settlement ponds and silt fences. (ii) The implementation of soil erosion mitigation measures will also mitigate against enhanced sedimentation.	IPDC / Contractor	During site clearing and throughout construction	Covered in Project Budget	See Monitoring Plan Ref.11.4.3(1)	AFDB OS1 World Bank Group EHS Guidelines Development Corporation Regulations (SNNP), 2017
	S3	Compaction Soil compaction results in the change of the original structure	(i) No mitigation possible	-	-	-	-	-
	S4	Dust creation If bare surfaces and soil stockpiles are not watered and vegetated, there will be high amounts of dust creation	(i) Bare surfaces, including stockpiles: - Long-term solution is to vegetate the soil as plant roots bind soil and protect the soil against the wind. Good vegetation coverage is necessary for this to be successful. - Short-term solution – for the period between stockpiling and plant growth – keep the stockpiles damp during high wind periods.	IPDC / Contractor	During site clearing and throughout construction	-	See Monitoring Plan Ref.11.4.3(1)	AFDB OS1 World Bank Group EHS Guidelines Development Corporation Regulations (SNNP), 2017
	S5	Soil contamination	(i) On-site pollutants should be contained in a bunded area and on an impermeable surface. (ii) One should maintain control of substances entering the site. (iii) Provide adequate disposal facilities. (iv) Enforce a non-polluting environment.	IPDC	Throughout Operation	Covered in Project Budget	See Monitoring Plan Ref.11.4.3(1)	AFDB OS1, OS4 World Bank Group EHS Guidelines Development Corporation Regulations (SNNP), 2017
Surface Water	SW1	Altering the hydrological regime- change in runoff volume	(i) Keep the hard standing areas as minimal as possible; (ii) Introduce pervious paving in areas such as parking bays.	IPDC / Enterprises	Throughout Operation	Covered in Project Budget	See Monitoring Plan Ref. 11.4.4(2)	World Bank Group EHS Guidelines Development Corporation Regulations (SNNP), 2017
	SW2	Altering the hydrological regime-change in runoff velocity	(i) Energy dissipaters should be implemented and maintained at each discharge point.	IPDC	During construction and throughout operation	Covered in Project Budget	See Monitoring Plan Ref. 11.4.4(2)	World Bank Group EHS Guidelines Development Corporation Regulations (SNNP), 2017

Environment	No.	Potential Impacts	Proposed Mitigation and Benefit Enhancement Measures	Institutional Responsibility For Implementation	Timeframe / Due Date	Cost Estimates	Comments / Further Action & Monitoring	Applicable Safeguards / Documents
Ground Water	GW1	Lowering of groundwater levels	(i) Supply alternate water sources to affected community members should an impact be identified	IPDC	Throughout Operation	To be determined is required	See Monitoring Plan Ref. 11.4.4(3)	World Bank Group EHS Guidelines Development Corporation Regulations (SNNP), 2017
	GW2	Contamination of groundwater resources	(i) Contain and treat surface water runoff in order to prevent it entering the groundwater environment; (ii) Monitor groundwater quality in the vicinity of the site; (iii) A groundwater monitoring programme should be initiated once the IAIP and RTC Sites become operational in order to identify any potential impacts to groundwater quality and quantity in the area; and (iv) Should negative groundwater related impacts be identified, alternative water supply options should be supplied to the affected communities.	IPDC	Throughout Operation	Covered in Project Budget See Monitoring Plan Ref. 11.4.4(3)	See Monitoring Plan Ref. 11.4.4(3)	AFDB OS1, OS4 World Bank Group EHS Guidelines Development Corporation Regulations (SNNP), 2017
	GW3	Loss of recharge area for the springs	(i) Monitor spring discharge in order to determine whether the SNNP IAIP site has had a detrimental impact. Provide alternate water source should an impact be identified.	IPDC	Throughout Operation	See Monitoring Plan Ref. 11.4.4(3)	See Monitoring Plan Ref. 11.4.4(3)	AFDB OS1, OS4 World Bank Group EHS Guidelines Development Corporation Regulations (SNNP), 2017
Wetland	W1	Direct loss/ degradation of natural wetland habitat & biota (Offsetting wetland loss through the creation and management of artificial wetland habitats)	(i) Creation of waterbodies within the site to offset the loss of the isolated depressions. (ii) These would be artificial isolated systems providing islands of aquatic habitat. There are provisions made for open waterbodies within the landscape plan, which would be able to provide similar services as the current waterbodies are providing. This is under the assumption that the waterbodies in the plan will be designed as far as possible to represent 'natural' systems. It is important that the correct species be utilised when constructing these waterbodies and that an operational maintenance plan is developed to ensure these waterbodies are maintained in a state that will continue to provide isolated habitat for aquatic-dependent species. The plan must include the control and maintenance of sediment and nutrient input into these systems to prevent sedimentation and potential eutrophication. (iii) The through-flow or circulation of water is also important to ensure water doesn't stagnate. The use of certain species such as *Typha* and *Cyperus* species must be managed to ensure they do not form dense communities throughout the waterbody resulting in a homogenous community (low biodiversity) and limited to no open water areas (decreasing habitat diversity). The maintenance of these systems will result in micro-hotspots of biodiversity that has the potential of supporting a variety of floral and faunal species. (iv) No alien invasive plant species must be utilised during the landscaping process. These introduced species will act as a	IPDC	Throughout Operation	See Monitoring Plan Ref. 11.4.4(2) and 11.4.4(3)	See Monitoring Plan Ref. 11.4.4(2) and 11.4.4(3)	AFDB OS1, OS4 World Bank Group EHS Guidelines Development Corporation Regulations (SNNP), 2017

Environment	No.	Potential Impacts	Proposed Mitigation and Benefit Enhancement Measures	Institutional Responsibility For Implementation	Timeframe / Due Date	Cost Estimates	Comments / Further Action & Monitoring	Applicable Safeguards / Documents
			source for infestations with sensitive areas such as the newly created artificial systems.					
	W2	Hydrological functioning/regime modifications	(i) The operational stormwater management system for the proposed development must be designed to ensure that runoff regimes post-construction activities matches that regimes pre-construction (i.e. without resulting in increased peak discharge to water resources, soil saturation in non-wetland areas and erosion/ sedimentation). All outlets must be designed to dissipate the energy of outgoing flows to levels that present a low erosion risk. (ii) The through-flow or circulation of water is also important to ensure water doesn't stagnate.	IPDC	Throughout Operation	See Monitoring Plan Ref. 11.4.4(2) and 11.4.4(3)	See Monitoring Plan Ref. 11.4.4(2) and 11.4.4(3)	AFDB OS1, OS4 World Bank Group EHS Guidelines Development Corporation Regulations (SNNP), 2017
	W3	Erosion and Sedimentation	(i) The stormwater management system for the proposed development must be designed to ensure that runoff regimes post-construction activities matches that regimes pre-construction (i.e. without resulting in increased peak discharge to water resources, soil saturation in non-wetland areas and erosion/ sedimentation). (ii) All outlets must be designed to dissipate the energy of outgoing flows to levels that present a low erosion risk. The use of sediment curtains is encouraged especially within downstream reaches of the R1 system.	IPDC	Throughout Operation	See Monitoring Plan Ref. 11.4.4(2) and 11.4.4(3)	See Monitoring Plan Ref. 11.4.4(2) and 11.4.4(3)	AFDB OS1, OS4 World Bank Group EHS Guidelines Development Corporation Regulations (SNNP), 2017
	W4	Water Quality	(i) No contaminated runoff from the site must be allowed to enter these systems. Any stormwater directed into these systems must not result in erosion and subsequent sedimentation of the water profile (sediment load). (ii) The quality of water exiting the site should be monitored in accordance with an approved monitoring programme to ensure the water from the site is not having a long-term adverse effect on the systems surrounding the site.	IPDC	Throughout Operation	See Monitoring Plan Ref. 11.4.4(2) and 11.4.4(3)	See Monitoring Plan Ref. 11.4.4(2) and 11.4.4(3)	AFDB OS1, OS4 World Bank Group EHS Guidelines Development Corporation Regulations (SNNP), 2017
Air Quality	AQ1 AQ2	Air quality impacts Increased particulate and gaseous concentrations affecting residential receptors within immediate vicinity of site boundary and receptors beyond site boundary	General recommendations for air quality management have been provided in the draft Development Control Regulations for SNNP (2017) and include: (i) Water the roads immediately before compacting to strengthen the road surface, otherwise traffic will soon beat back the road surface to pre-bladed condition; (ii) When possible, delay compacting until the beginning of the wet season or when water becomes more available; (iii) Ensure that vehicles and other equipment are regularly inspected according to schedule maintenance for proper exhaust emission; (iv) Truck drivers to minimise speed limits on earthen roads, especially in dry periods; (v) Avoid burning of biomass as much as possible and use fire only in situations where this is least possible environmental damage; (vi) Speed control using speed bumps; with permanent speed bumps to be installed in villages and bazaars to reduce traffic speeds in inhabited areas;	IPDC / Enterprises	Throughout Operation	Covered in Project Budget See Monitoring Plan Ref. 11.4.4(4) Design costs to be determined by each enterprise at design stage	See Monitoring Plan Ref. 11.4.4(4)	AFDB OS1, OS4 World Bank Group EHS Guidelines USEPA, 1995 Development Corporation Regulations (SNNP), 2017

Environment	No.	Potential Impacts	Proposed Mitigation and Benefit Enhancement Measures	Institutional Responsibility For Implementation	Timeframe / Due Date	Cost Estimates	Comments / Further Action & Monitoring	Applicable Safeguards / Documents
			(vii) If water is available, the road surface can be sprayed on a frequent schedule; (viii) Bitumen surface roads to be constructed in bazaars, with speed controls implemented; (ix) Dense vegetation planted on the roadside; and (x) Schedule work activities to minimise disturbance. Preparation of an Environmental Management Plan is also required for formulation, implementation and monitoring of environmental protection measures during and after commissioning of the project. As part of this this, the following is applicable to air quality: (xi) Regular monitoring of fugitive emissions shall be conducted and any abnormalities reported for immediate corrective measures; (xii) Regular monitoring of ambient air quality in and around the site shall be conducted; (xiii) Unauthorised clearing and removal of vegetation should be prohibited; (xiv) Normal means of dust suppression, including watering of roads, will be employed to minimise dust generation. (xv) Occupational dust levels are to be monitored and managed as required. (xvi) The size and area of stockpiles of soil will be minimised. Stockpiles that may be susceptible to erosion must be terraced, covered or have suitable erosion control measures such as silt fences; (xvii) Access routes will use established roads where possible; (xviii) The moisture content of access road surface layers will be maintained through routine directional spraying or the use of an appropriate dust suppressant as agreed with the Concerned Authority; and (xix) Off-road driving and the creation of new roads/tracks will be avoided wherever possible. (xx) Recommendations provided in the IFC EHS Guidelines for Air Emissions and Ambient Air Quality are to be considered during design of facilities to be established within the IAIP and RTC. Sectoral specific EHS guidelines have also been developed for the following: - Breweries; - Meat processing; - Dairy processing; and - Food and beverage processing. Refer to **Annexure 11.2 for Sector Specific Guidelines**					
Noise	N1	Acoustic impacts Degradation of noise climate / annoyance on residential receptors within and	(i) Units with significant noise generating potential are to be housed within closed-wall buildings to limit the transmission of noise to surrounding receptors. (ii) As per the IFC EHS Guidelines for Noise Management, the following noise reduction options should also be considered: - Selecting equipment with lower sound power levels;	IPDC / Enterprises	Throughout Operation	Covered in Project Budget See Monitoring Plan Ref. 11.4.4(5)	See Monitoring Plan Ref. 11.4.4(5)	AFDB OS1, OS4 World Bank Group EHS Guidelines Development Corporation

Environment	No.	Potential Impacts	Proposed Mitigation and Benefit Enhancement Measures	Institutional Responsibility For Implementation	Timeframe / Due Date	Cost Estimates	Comments / Further Action & Monitoring	Applicable Safeguards / Documents
		beyond 200m of the site boundary	- Installing silencers for fans; - Installing suitable mufflers on engine exhausts and compressor components; - Installing acoustic enclosures for equipment casing radiating noise; - Improving the acoustic performance of constructed buildings by applying sound insulation; - Installing acoustic barriers without gaps and with a continuous minimum surface density of 10 kg/m^2 in order to minimize the transmission of sound through the barrier. Barriers should be located as close to the source or to the receptor location to be effective; - Installing vibration isolation for mechanical equipment; - Re-locating noise sources to less sensitive areas to take advantage of distance and shielding; - Siting permanent high noise generating facilities away from community areas if possible; - Taking advantage of the natural topography as a noise buffer during facility design; - Reducing project traffic routing through community areas wherever possible; and - Developing a mechanism to record and respond to complaints. As per the Development Control Regulation document for the SNNP site (MACE, 2017), the following site designs will be followed: (iii) Windows and openings to all building spaces intended for human occupancy shall be orientated away from sources of distractive noise or shall be provided with protections acceptable to the building official; (iv) Regular monitoring of ambient noise in and around the site shall be conducted; and (v) Alert public when loud noise will be generated.					Regulations (SNNP), 2017
Transport and Access	T1	Traffic impacts	(i) It is recommended that due to the high traffic volumes to and from the IAIP during operation, and the single access, that the access configuration should be upgraded. This will assist to decrease the risk of vehicle/vehicle and vehicle/NMT accidents in the vicinity of the site. The mitigation measures (intersection upgrades, etc.) are to be in place from the Construction phase. (ii) The required road signs, road markings and street lighting should also be implemented at the accesses to ensure good intersection operation and safety. (iii) It is recommended that the trip generation of the IAIP and RTC facilities be monitored annually to ensure that the access intersections operate safely and with sufficient capacity and acceptable levels of service.	IPDC / FDRE	During construction and throughout Operation	Covered in Project Budget See Monitoring Plan Ref. 11.4.4(7) TBD	See Monitoring Plan Ref. 11.4.4(7)	AFDB OS1 World Bank Group EHS Guidelines Development Corporation Regulations (SNNP), 2017

Environment	No.	Potential Impacts	Proposed Mitigation and Benefit Enhancement Measures	Institutional Responsibility For Implementation	Timeframe / Due Date	Cost Estimates	Comments / Further Action & Monitoring	Applicable Safeguards / Documents
			(iv) If the intersection performance deteriorates to unacceptable levels in future, additional intersection upgrades should be implemented.					
Waste Management	WM1 WM2 WM3 WM4	Waste Impacts	(i) Provide segregated waste receptacles to each Enterprise operating within the IAIP or RTC. (ii) Encourage Enterprises to operate a clean site policy and ensure waste receptacles are easily available and ensure all their staff are properly trained on the contents of the overarching Waste Management Plan (WMP). (iii) IPDC must ensure that waste is collected at least once a week for all Enterprises and where there is greater waste being generated by an Enterprise, waste collection must increase to twice a week for those specific Enterprises. (iv) Provide dedicated bins for hazardous waste, located on hardstanding within the designated Waste Management Area. (v) All Enterprises that generate hazardous waste must be required to deliver this to the waste management area every third day. (vi) Apply the waste hierarchy and prevent waste from being generated. The site will operate on a zero waste discharge basis and therefore, no waste, with the exception of small quantities of hazardous waste will be permitted to be disposed of outside of the IAIP and RTC. (vii) Operate a 'Zero Waste Discharge' facility. (viii) Enforce the implementation of the Waste Hierarchy. (ix) Ensure all Enterprises are contractually committed to implementing the WMP. (x) No waste from the IAIP and RTC sites may be permitted to be disposed of within a landfill with the exception of small quantities of industrial hazardous Waste and bio-medical waste. Since there are no sanitary landfills within Yirga Alem and Dilla which are the closest urban areas to the site, these wastes must be transported to the nearest sanitary landfill. (xi) Limit the volumes of residual wastes, industrial hazardous waste and bio-medical wastes streams. (xii) Encourage Enterprises to use alternative products to reduce hazardous rating. (xiii) Investigate and support the development of a Sanitary Landfill within the vicinity of the sites.	IPDC / Enterprises	Throughout Operation	Covered in Project Budget	See Monitoring Plan Ref. 11.4.4(6)	AFDB OS1, OS4 World Bank Group EHS Guidelines Development Corporation Regulations (SNNP), 2017 Waste Management Plan
Visual	V2	Light Pollution	The following mitigation measures can be implemented in order to minimise impacts from the lighting design of the facility: (i) Light spills can be completely avoided by careful lamp design selection and positioning. (ii) Lighting near or above the horizontal should be avoided to reduce glare and sky glow (the brightening of the night sky). (iii) Good design, correct installation and ongoing maintenance are essential to the effectiveness of lighting schemes. (iv) Lighting schemes should be designed to ensure unnecessary or superfluous lighting is turned off when not needed. Apply 'part-	IPDC	During Construction and operation	Covered in Project Budget	None required	World Bank Group EHS Guidelines Development Corporation Regulations (SNNP), 2017

Environment	No.	Potential Impacts	Proposed Mitigation and Benefit Enhancement Measures	Institutional Responsibility For Implementation	Timeframe / Due Date	Cost Estimates	Comments / Further Action & Monitoring	Applicable Safeguards / Documents
			night lighting' to reduce any potential adverse effects e.g. when a business is closed or, in outdoor areas, switching-off at quiet times between midnight and 5am or 6am. (v) Impact on sensitive wildlife receptors throughout the year, or at particular times (e.g. on migration routes), may be mitigated by the design of the lighting or by turning it off or down at sensitive times.					
	V3	Roads and /or road widening	The following mitigation measures can be implemented in order to minimise impacts from permanent vegetation clearing and road construction: (i) Establish vegetative screens /shelterbelts along highly visible roads. (ii) Natural vegetation must be re-established on disturbed areas after construction. (iii) Roads and drainage for runoff should be appropriately stabilised to avoid erosion and visual scars.	IPDC	During construction and operation	Covered in Project Budget	None required	World Bank Group EHS Guidelines Development Corporation Regulations (SNNP), 2017
Biodiversity (Yirga Alem IAIP)	B1 B2 B3 B4	Re-vegetation of indigenous plant species in greenery areas. Disturbance and Electrocutions of avian species. Water quality deterioration / pollution of surrounding water resources. Attraction of wild animals by food wastes and due to increased contact with people.	The following mitigation measures are to be implemented. (i) Appropriate selection of natural vegetation; (ii) Undertake monitoring of the birds & their flyway on regular basis; (iii) Use of birds friendly power lines and associated infrastructures; (iv) Design and implement proper solid & liquid waste management; (v) Effective disposal of materials and garbage in designated waste disposal sites; (vi) Launching awareness creation programs for the whole staff; (vii) Avoiding feeding and any contact with wild animals. (viii) Develop human- wildlife conflict resolution systems; (ix) Adoption of conventional sewage treatment facilities and solid waste management.	IPDC SNNP Regional EPLAUA and its associated Woreda level office	Prior to operation and throughout operation	Covered in Project Budget	See Monitoring Plan Ref. 11.4.4(8)	AFDB OS1, OS3 World Bank Group EHS Guidelines Development Corporation Regulations (SNNP), 2017
Biodiversity (Dilla RTC)	B1 B2 B3 B4	Re-vegetation of indigenous plant species in greenery areas and use of local community agro-forestry practices. Disturbance of birds and primates (Vervet monkey and Guereza) Chichu River and other sources water quality deterioration and pollution Attraction of wild animals by wastes	The following mitigation measures are to be implemented. (i) Apply the indigenous knowledge of Gedeo community. (ii) Appropriate selection of natural vegetation. (iii) Undertake monitoring of the birds & their flyway on regular basis; (iv) Avoid disturbance of usual feeding sites of the primates; (v) Design and implement proper solid & liquid waste management; (vi) Avoid any drainage to Chichu River and other water sources; (vii) Effective disposal of materials and garbage in designated waste disposal sites. (viii) Launching awareness creation programs; (ix) Avoiding feeding and any contact with wild animals. (x) Develop human-wildlife conflict resolution systems;	IPDC SNNP Regional EPLAUA and its associated Woreda level office	Prior to operation and throughout operation	Covered in Project Budget	See Monitoring Plan Ref. 11.4.4(8)	AFDB OS1, OS3 World Bank Group EHS Guidelines Development Corporation Regulations (SNNP), 2017

Environment	No.	Potential Impacts	Proposed Mitigation and Benefit Enhancement Measures	Institutional Responsibility For Implementation	Timeframe / Due Date	Cost Estimates	Comments / Further Action & Monitoring	Applicable Safeguards / Documents
			(xi) Adoption of conventional sewage treatment facilities and solid waste management.					
Socio-Economic	SE1	Employment and Economy	(i) Maintain and regularly update a separate web page on the developer website dedicated to local tenders for the provision of goods and services. Such webpage should be widely publicised by the developer. (ii) A Worker Influx Management Plan will need to be prepared to define labour practices in line with international standards that will need to be applied by EPC Contractors and their subcontractors, as well as in the Project's supply chain. The Worker Influx Management Plan will need to be aligned with the developer's Grievance Procedure to ensure that the procedure is consistently implemented across all Project activities.	IPDC	Throughout operation	Covered in Project Budget	See Monitoring Plan Ref. 11.4.4(9)	AFDB OS1, OS5 World Bank Group EHS Guidelines Development Corporation Regulations (SNNP), 2017
	SE2	Livelihood/Sources of Income	(i) Land acquisition and any displacement impacts on the project will be carried out in compliance with Ethiopian law and AfDB Operational Safeguard 2- Involuntary Resettlement (OS2). (ii) The MoI and the IAIP Developer will seek to avoid physical displacement where possible, and to minimise economic displacement. (iii) Impacts on land and livelihoods shall be compensated. (iv) Any affected standing crops will be compensated at current market value to make sure farmers do not lose harvest. (v) The affected Orphan land, i.e. the remaining portion of the land plot that remains with the farmer but made uneconomic and/or too small to use, will be compensated in full; (vi) Affected people will have access to a grievance mechanism, including a first tier of internal grievance review by the IAIP Developers, with the possibility for aggrieved individuals to resort to a second tier of independent review of the grievance. (vii) Vulnerable people will be identified and specifically assisted as needed. (viii) Stakeholder Engagement Plan (SEP) implementation with regards to keeping a regular dialogue with local communities, and in particular, with affected people. (ix) The IPDC/PIU need to follow the Resettlement Action Plan and monitor internally and externally to ensure compliance the AfDB OS2 and National policies and measure if the PAPs' livelihood has at least stayed the same or ideally, improved as a result of land acquisition.	IPDC	Throughout operation	Covered in Project Budget	See Monitoring Plan Ref. 11.4.4(9)	AFDB OS1, OS5 World Bank Group EHS Guidelines Development Corporation Regulations (SNNP), 2017
	SE3	Community Health	(i) Implementation of a Health and Safety Management Policy and Worker Influx Management Plan. (ii) Provide the project HSE and Worker Influx Management Policies to all subcontractors during formal induction, including the security firms. (iii) One "umbrella" Project Grievance Mechanism, extended and accessible to all workers, those who directly work for the IAIPs development and also employed by contractors.	IPDC	Throughout operation	Covered in Project Budget	See Monitoring Plan Ref. 11.4.4(9)	AFDB OS1, OS5World Bank Group EHS Guidelines Development Corporation Regulations (SNNP), 2017

Environment	No.	Potential Impacts	Proposed Mitigation and Benefit Enhancement Measures	Institutional Responsibility For Implementation	Timeframe / Due Date	Cost Estimates	Comments / Further Action & Monitoring	Applicable Safeguards / Documents
			(iv) The developer will ensure that EPC Contractors will provide onsite first-aid tents (one tent per site) to ensure that basic medical attention and first aid treatment can be provided by a trained first-aider during the hours that the work is being undertaken at the Project site. For all medical incidents that require medical attention, the EPC contractors will quickly provide transportation to the Workers' Camp clinic which will also help reduce the potential pressure on local healthcare facilities (v) On-going monitoring and evaluation of the community health situation will be needed. If monitoring indicates an increase in the transmission of communicable diseases, the mitigation measures will need to be revised.					
	SE3	Community Safety and Security	(i) Ensure that a Project Code of Conduct and appropriate training for security personnel are implemented to ensure best practice in running a secure site and implementing the Code of Conduct that fosters behaviours that help to avoid, eliminate or minimise the use of excessive force in potential conflict situation. (ii) The project implementation team to carry out regular internal audits of the HSE Management system implementation. (iii) The project Health and Safety Management Policy is discussed with all staff and new employees, and imposes no tolerance to drugs and alcohol, AIDS prevention leaflets, etc. (iv) Stakeholder Engagement Plan (SEP) implementation with regards to keeping a regular dialogue with local communities. (v) One "umbrella" Project Grievance Mechanism, extended and accessible to all employees and staff, those who directly work directly for the IAIP project and also employed by contractors.	IPDC	Throughout operation	Covered in Project Budget	See Monitoring Plan Ref. 11.4.4(9)	AFDB OS1, OS5World Bank Group EHS Guidelines Development Corporation Regulations (SNNP), 2017
	SE4	Environmental Emissions	Refer to Air Quality Section of ESMP.				See Monitoring Plan Ref. 11.4.4(4)	
	SE5	Community Infrastructure and Services	(i) Continue regular dialogue with local authorities whose job is to ensure adequate infrastructure for the developing areas/settlements. Continue to implement a community health management plan in consultation with relevant stakeholders (e.g. local doctors and the local authorities). This plan will ensure that appropriate and adequate health care services are provided on site to address/ manage staff/personnel illnesses and injuries during the IAIP operations.	IPDC	Throughout operation	Covered in Project Budget	See Monitoring Plan Ref. 11.4.4(9)	AFDB OS1, OS5World Bank Group EHS Guidelines Development Corporation Regulations (SNNP), 2017
Cultural Heritage (Dilla RTC)	CH1	Disturbance during prayer days at Orthodox church by dust and noise at the RTC	The following mitigation measures are to be implemented during the Project development. (i) Mitigation measures as per air quality and noise impacts to be implemented	IPDC / Contractor	Prior to construction and throughout construction	Covered in Project Budget	See Monitoring Plan Ref. 11.4.4(4) and 11.4.4(5)	AFDB OS1, OS5 World Bank Group EHS Guidelines Development Corporation Regulations (SNNP), 2017

11.4 ENVIRONMENTAL AND SOCIAL MONITORING PROGRAMME

11.4.1 OVERVIEW

Environmental monitoring is an essential tool in relation to environmental management as it provides the basis for rational management decisions regarding impact control. Monitoring should be performed during all stages of the project to verify the impact predictions and to ensure that the impacts are no greater than predicted.

By using the information collected through monitoring, environmental management plans can be improved when necessary (e.g. adapting mitigation measures to changing situations throughout the project construction and operation) to ensure that the anticipated impacts are mitigated. Should the environmental monitoring determine construction works or operations pose an environmental concern; the works or operation will be modified or halted.

The objectives of the environmental monitoring programme include the following:

- To monitor the changes in the environmental conditions by the construction and operation of the proposed Project;
- To check on whether mitigation and benefit enhancement measures have actually been adopted, and are proving effective in practice;
- To provide a means whereby any impacts which were subject to uncertainty at the time of preparation of the ESIA, or which were unforeseen, can be identified, and to provide a basis for formulating appropriate additional impact mitigation measures; and
- To provide information on the actual nature and extent of key impacts and the effectiveness of mitigation and benefit enhancement measures which, through a feedback mechanism, can improve the planning and execution of future, similar projects.

There are two basic forms of monitoring:

- Compliance monitoring, which checks whether prescribed actions have been carried out, usually by means of inspection or enquiries, and
- Effects monitoring which records the consequences of activities on one or more environmental components, and usually involves physical measurement of selected parameters or the execution of surveys to establish the nature and extent of induced changes.

For this project, it is recommended to carry out both compliance and effects monitoring. However, during construction compliance monitoring will play a major role in checking whether recommended impact mitigation and management plans have been carried out or not. This is because most impact control takes the form of measures incorporated in project designs and contract documents. The extent to which recommendations on these matters, as set out in the ESIA and ESMP, are complied with plays a major part in determining the overall environmental performance of the project.

The environmental monitoring plan outlined below and summarised in **Table 11-4** and **Table 11-7** describes the particular resources that will be monitored through the construction and operation phases of the project respectively. The types of data that will be collected to describe each resource are also included in these tables.

11.4.2 MONITORING TO ESTABLISH BASELINE

The quality of environmental assessment is usually, to a large extent, constrained by limitation of baseline information and data time series. The environmental baseline conditions, which will form a basis for some of the monitoring activities, were determined by the ESIA studies during the pre-construction Phase. However, there is a need for additional information about present status and development trends for good predication of impacts of the project environment.

A monitoring regime is to begin at the earliest convenience to be established against which changes during construction, and on into operation, can be assessed.

Therefore, it is recommended for the IPDC to set-up an environmental and social monitoring system and establish a databases as well as support system for data storage and dissemination. Such system might be established for general state of the environment reporting.

11.4.3 MONITORING PLAN: CONSTRUCTION PHASE

(1) GENERAL

Environmental monitoring during the construction phase will comprise two principal groups of activities:

- Review of the contractor's plans, method statements, temporary works designs, and arrangements so as to ensure that environmental protection measures specified in the contract documents are adopted, and that the contractor's proposals provide an acceptable level of impact control.
- Systematic observation of all site activities and the contractor's offsite facilities including stockpile areas, as a check that the contract requirements relating to environmental matters are in fact being complied with, and that no impacts foreseen and unforeseen are occurring.

Most of the monitoring will comprise visual observations during site inspection and will be carried out at the same time as the engineering monitoring activities. Site inspections will take place with emphasis on early identification of any environmental problems and the initiation of suitable remedial action. Where remedial actions have been required on the part of the contractor, further checks will need to be made to ensure that these are actually being implemented to the agreed schedule and in the required form. All sites where construction is taking place will be formally inspected from an environmental viewpoint on a regular basis.

These activities will also be integrated with other construction supervision and monitoring activities to be carried out by the IPDC. The IPDC will decide on the appropriate course of action to be taken in cases where unsatisfactory reports are received from field staff regarding environmental matters. In the case of relatively minor matters, advice to the contractor on the need for remedial action may suffice, but in all serious cases, the IPDC should issue a formal instruction to the EPC Contractor to take remedial action, depending on the extent of his delegated powers.

The IPDC, as an implementing agency of this project, has the responsibility to be involved with the construction supervision team to see the implementation of this environmental monitoring plan. The IPDC will establish an Environmental Management Unit (EMU) at site office level and is responsible to coordinate the environmental management and monitoring activities on a day-to-day basis.

The EPC contractor will assign an Environmental Inspector and to undertake check monitoring on an intermittent basis.

Furthermore, condition 24(2) of the Industrial Park Proclamation No. 886/2015 states that, "*The Ministry of Environment and Forest shall establish an office within industrial parks for the application, supervision, protection and enforcement of environmental norms, standards, safeguards, management and mitigation plans within the Industrial Parks*".

In addition to visual observation, it is particularly important that monitoring should also include limited informal questioning of members of the local community and their leaders who live near to the project since they may be aware of matters which are unsatisfactory, but which may not be readily apparent or recognised during normal site inspection visits.

In the following sections, monitoring activities are presented for various impact components during the construction phase. **Table 11-4** below outlines the overall package of environmental monitoring that will be carried out in relation to the Project. The table also assigns responsibilities for each monitoring activity, and proposes parties capable of carrying out the monitoring on behalf of the IPDC.

(2) SOIL EROSION

The EMU is to ensure the effectiveness of erosion and sedimentation control measures to be implemented during the construction stage.

(3) SURFACE WATER QUALITY

Monitoring of water quality will ensure proper implementation of the identified mitigation measures for the construction phase and complying with the Water Pollution Control Regulation.

The water quality monitoring program should also include the potable water supplied to the construction work camps and work sites. Periodical water analysis of the drinking water provided to the workers and an awareness program on safe water shall be performed in order to limit waterborne diseases.

(4) AIR QUALITY

Particulate matter (PM) at the constructions sites and roads used by trucks for haulage of materials, will be visually monitored. Monitoring will be carried out throughout the construction activities on a daily basis. If nuisance dust is generated around the site during the construction period, it will be the responsibility of EMU to ensure that appropriate control measure are taken.

Inspection of stock piled material sites is to be undertaken on a regular basis to ensure suitable mitigation measures are in place. In addition, trucks and machinery shall occasionally be inspected unannounced regarding engine emissions (i.e., when black clouds of soot are visible). Engine maintenance shall be requested in case of any deficiency noticed.

(5) NOISE

The implementation of the identified mitigation measures will be monitored during construction activities. The noise level at construction sites will be monitored with portable sound level meters once a week, during normal construction activities, and upon receipt of complaints. Thus compliance with the Regulation on the Assessment and Management of the Environmental Noise and Regulation of Worker's Health and Work Safety will be ensured.

If nuisance noise is generated around settlement areas during the construction period, it will be the responsibility of the EMU to ensure that appropriate control measure are taken.

(6) WASTE MANAGEMENT

Wastes will be handled to ensure compliance with related Ethiopian Legislation, and internationally accepted standards. To handle all types of wastes properly during construction, a waste management plan has been prepared and implementation of the measures proposed in the plan will be monitored regularly to comply with all relevant legislation and standards.

All the records for storage, transportation and treatment of these wastes will be kept as required by the management plans. The EMU shall check on regular basis the activity in the waste management areas.

(7) NATURAL VEGETATION

It is the responsibility of the EMU together with the Woreda office of Agriculture and Rural Development to ensure that the recommended mitigation measures for natural vegetation are implemented. Parameters to be monitored include areas of woodland in the vicinity of the project sites to ensure deforestation does not take place. The monitoring would allow EMU to assess that the cutting and removal of trees and bush is carried out in accordance with proper forest conservation practices.

Additionally monitoring of

- The rehabilitation and re-vegetation of the areas affected during construction process;
- Habitat change/prevalence of invasive species;
- Of locally sensitive areas that require consideration;
- Identification of approved disposal site and a system for supervision and monitoring;

- Prevalence of human-wildlife conflict / behavioural change.

(8) EQUIPMENT, FUEL STOAGE AND MAINTENANCE

It will be the responsibility of the EMU to check on the proper storage and operations of equipment, fuel storage and handling facilities and maintenance areas to ensure these facilities are safe and secure.

(9) SOCIO-ECONOMIC

COMMUNITY HEALTH

On-going monitoring and evaluation of the community health situation is to be undertaken. If monitoring indicates an increase in the transmission of communicable diseases, the mitigation measures will need to be revised.

SAFETY

Occupational health and safety issues of the IAIP and RTC operation will be monitored to ensure compliance with legislation related to occupational health and safety management.

COMPENSATION AND RESETTLEMENT

Monitoring of the following aspects are to be undertaken:

- Changes in economic and social status of compensated and resettled population including livelihood improvement, effectiveness and timing of public information/participation and consultation activities;
- Implementation and effectiveness of social development plans;
- Effectiveness of resettlement planning, complaints or grievances regarding resettlement and effectiveness of corrective/preventive activities performed for them.

The main type of monitoring to be adopted for the purpose of this project will be both internal and external performance monitoring. Accordingly, the IPDC will undertake continuous and systematic performance monitoring of the resettlement process.

Table 11-4: Monitoring Plan - Construction Phase

No.	Parameter to be monitored	Location	Measurement	Frequency	Institutional Responsibility	Cost (Birr)
1	Erosion and Sedimentation	Construction sites, stockpile areas, access roads	Observation and reporting regarding the provisions in Erosion and Sediment Control Plan	Continuous controls and monthly reporting	EPC Contractor, EMU	Covered in Project Budget
2	Air Quality	Construction sites, stockpile areas, access roads	Observation and inspection	Continuous throughout the construction period	EPC Contractor, EMU	Covered in Project Budget
3	Air Quality	Trucks and machinery exhausts	Observation and inspection	Occasionally throughout construction period	EPC Contractor, EMU	Covered in Project Budget
4	Noise	Near settlements and construction sites	Portable sound level meters for measuring noise levels	Once a week and upon complaints	EPC Contractor, EMU	200,000 for equipment
5	Waste Management	At construction sites and camp facilities	Observation and record keeping	Monthly	EPC Contractor, EMU	Covered in project budget
6	Natural Vegetation	IAIP site	Observation and record keeping	Monthly	EMU / ARD	Covered in project budget
6	Equipment, fuel storage and handling and maintenance	Construction camp and workshop	Visual inspection	Monthly	EPC Contractor, EMU	Covered in project budget

No.	Parameter to be monitored	Location	Measurement	Frequency	Institutional Responsibility	Cost (Birr)
7	Health and Safety	All work places	Observation inspection and reporting	Daily / Monthly	EPC Contractor, EMU	Covered in Project budget
8	Environmental Monitoring Coordination	-	Monitoring of the implementation and success of the mitigation measures (including the relevant environmental and health and safety plans) Reporting on monitoring results, and compliance with relevant legislation, contract and technical requirements	Monitoring continuously Reporting bi-annually	EMU / EPC Contractor	100,000 per year
9	Resettlement and Socioeconomic	Monitoring of the Resettlement Action Plan (for details see RAP Report)				

11.4.4 MONITORING PLAN: OPERATION PHASE

Monitoring will be an integrated part of operation of the project to comply with the standards and improve management practices.

The principal fields of interest requiring monitoring during operation phase are discussed below and summarized in **Table 11-7**.

(1) SOIL EROSION

The EMU is to ensure the effectiveness of erosion control measures to be implemented during the operation phase.

(2) SURFACE WATER QUALITY

Monitoring of water quality will ensure proper implementation of the identified mitigation measures for the construction phase and complying with the Water Pollution control Regulation.

The surrounding water courses must be monitored upstream and downstream of the IAIP site. Details of the monitoring protocols are defined below.

SAMPLING LOCATION AND FREQUENCY

YIRGA ALEM IAIP

The Gidabo River must be monitored on a monthly basis upstream and downstream of the IAIP site. Three surface water sampling locations have been identified and are summarised in **Table 11-5**.

Table 11-5: IAIP Surface Water Sampling Locations

Sample name	Sampling Point	Easting	Northing
SNNPSW01	Downstream of site	424999.15 m E	743118.49 m N
SNNPSW02	Perpendicular to site	427047.82 m E	745364.52 m N
SNNPSW03	Upstream of site	428120.73 m E	746308.91 m N

DILLA RTC

The stormwater discharge leaving the RTC site must be monitored on a monthly basis at each of the discharge points as identified in **Table 11-6**.

Table 11-6: RTC Surface Water Sampling Locations

Sample name	Sampling Point	Latitude	Longitude
RTC SW01	Discharge Point 1	Identify on completion of construction phase	Identify on completion of construction phase
RTC SW02	Discharge Point 2	Identify on completion of construction phase	Identify on completion of construction phase
RTC SW03	Discharge Point 3	Identify on completion of construction phase	Identify on completion of construction phase

SAMPLING METHODOLOGY

The surface water samples must be collected directly into laboratory supplied sample containers. Surface water samples must be obtained from at least 10cm below the water surface (wherever possible), with the bottle opening facing upstream. Sample containers must be kept closed and in a clean condition up to the point of sampling.

Monitoring must be undertaken according to internationally accepted protocols, ensuring that the potential for cross contamination is minimised (i.e. during sampling, new disposable latex gloves must be worn at each sampling point).

For each sampling point, the temperature, pH and electrical conductivity must be measured in-situ using a calibrated multi-parameter and recorded. This information, as well as the physical and environmental information of each sampling point (e.g. visual, olfactory observations and flow conditions) must be recorded on designated field data sheet.

On each sample, the following must be recorded to ensure proper identification:

- Site Name (e.g. SNNP IAIP);
- Sample Location and Sample Type (e.g. SNNP SW01); and
- Sample Date and Time.

Sample containers must be kept closed and in a clean condition up to the point of sampling. Post sampling, all samples must be stored in a temperature controlled cooler box (below 4ºC), which is kept sealed and dust-free, until samples are dispatched to the laboratory for analysis. Any glass sample vessels must be wrapped in bubble wrap to prevent breakages.

ANALYTICAL PROGRAMME

The analytical schedule for the surface water samples is included in the below:

- Metals and metalloids: aluminium, arsenic, barium, beryllium, boron, cadmium, chromium, copper, iron, lead, manganese, mercury, nickel, potassium, selenium, vanadium and zinc;
- Anions: chloride, cyanide, phosphate, sulphate fluoride, ammoniacal nitrogen as N and NH_3, TON, nitrate as N and nitrite as N;
- Chemical Oxygen Demand (COD);
- Biological Oxygen Demand (BOD);
- General: TOC, pH, electrical conductivity, DO, TDS and Total Suspended Solids (TSS).

The pH and electrical conductivity measured in-situ must be validated through laboratory testing.

DATA QUALITY

A factual and interpretive report should be drafted in accordance with the monitoring reporting requirements stipulated in the IFC guidelines. The report should include a description of the methodologies followed, the analytical results obtained and associated interpretation in line with the defined water quality guidelines.

The precision of the sampling and analysis must be assessed through a comparison of the original and duplicate sample analytical results. This must be done through a quality assurance/quality control programme (i.e. obtain the percentage variance of the duplicated sample).

Should negative surface water related impacts be identified at root cause investigation should be undertaken and corrective actions identified and implemented.

(3) GROUNDWATER MONITORING

A water quality monitoring program with adequate resources and management oversight should be developed and implemented to meet the objective(s) of the monitoring program. The monitoring program should be initiated once the IAIP and RTC Sites become operational.

Groundwater monitoring should be conducted on a quarterly basis.

As there are currently a limited number of accessible groundwater abstraction points in the areas surrounding both Sites, additional monitoring borehole may be required. This should be assessed once the proposed water supply programme for the IAIP and RTC Sites has been finalised, as the location of the water supply boreholes will be the main driving factor behind the design of the monitoring programme.

The programme should ensure that monitoring wells are positioned both up gradient and down gradient of the operations, and be positioned to provide adequate information on water quality

between the site and potential down gradient receptors. Monitoring boreholes should take preferential groundwater flow paths into consideration.

The water monitoring program should consider the following elements:

- *Monitoring parameters:* The parameters selected for monitoring should be indicative of the pollutants of concern from the process, and should include parameters that are regulated under compliance requirements;
- *Monitoring type and frequency*: Wastewater monitoring should take into consideration the discharge characteristics from the process over time. Monitoring of discharges from processes with batch manufacturing or seasonal process variations should take into consideration of time-dependent variations in discharges and, therefore, is more complex than monitoring of continuous discharges. Effluents from highly variable processes may need to be sampled more frequently or through composite methods. Grab samples or, if automated equipment permits, composite samples may offer more insight on average concentrations of pollutants over a 24-hour period. Composite samplers may not be appropriate where analytes of concern are short-lived (e.g., quickly degraded or volatile).
- *Monitoring locations*: The monitoring location should be selected with the objective of providing representative monitoring data. Effluent sampling stations may be located at the final discharge, as well as at strategic upstream points prior to merging of different discharges. Process discharges should not be diluted prior or after treatment with the objective of meeting the discharge or ambient water quality standards. Monitoring boreholes should be placed both up gradient and down gradient of the operations, and take preferential groundwater flow paths into consideration
- *Data quality*: Monitoring programs should apply internationally approved methods for sample collection, preservation and analysis. Sampling should be conducted by or under the supervision of trained individuals. Analysis should be conducted by entities permitted or certified for this purpose. Sampling and Analysis Quality Assurance/Quality Control (QA/QC) plans should be prepared and, implemented. QA/QC documentation should be included in monitoring reports.

Should negative groundwater related impacts be identified, alternative water supply options should be supplied to the affected communities

(4) AIR QUALITY MONITORING

Regular monitoring of ambient air quality, and fugitive emissions, in and around the site shall be conducted during the operation phase, following commencement of the park.

(5) NOISE MONITORING

Regular monitoring of ambient noise in and around the site is to be conducted during the operation phase, following commencement of the park. Should complaints be received at any point noise monitoring is to be undertaken to determine the source of the noise and corrective actions are to be identified and implemented.

(6) WASTE MONITORING

Regular monitoring of waste management areas in and around the site is to be conducted during the operation phase, following commencement of the park.

(7) TRAFFIC MONITORING

The trip generation of the IAIP and RTC facilities is to be monitored annually, during the operational phase, to ensure that the access intersections operate safely and with sufficient capacity and acceptable levels of service.

(8) BIODIVERSITY

Undertake monitoring of the birds & their flyway on regular basis with regards to high tension transmission lines.

(9) SOCIO-ECONOMIC

COMMUNITY HEALTH

On-going monitoring and evaluation of the community health situation is to be undertaken. If monitoring indicates an increase in the transmission of communicable diseases, the mitigation measures will need to be revised.

SAFETY

Occupational health and safety issues of the IAIP and RTC operation will be monitored to ensure compliance with legislation related to occupational health and safety management.

COMPENSATION AND RESETTLEMENT

Monitoring of the following aspects are to be undertaken:

- Changes in economic and social status of compensated and resettled population including livelihood improvement, effectiveness and timing of public information/participation and consultation activities;
- Implementation and effectiveness of social development plans;
- Effectiveness of resettlement planning, complaints or grievances regarding resettlement and effectiveness of corrective/preventive activities performed for them.

The main type of monitoring to be adopted for the purpose of this project will be both internal and external performance monitoring. Accordingly, the IPDC will undertake continuous and systematic performance monitoring of the resettlement process.

(10) CONSTRUCTION SITE RESTORATION

This programme will be maintained for only a short duration during the construction period and the clean-up of the construction site. The programme will have the responsibility of ensuring that the EPC contractor implement environmental precautions and that the required landscaping and re-vegetation programme are implemented as part of the construction demobilisation process.

11.4.5 CHECKING AND CORRECTIVE ACTION

INSPECTION OF ENVIRONMENTAL PERFORMANCE AND MONITORING

Environmental monitoring of site activities is undertaken through a set of inspection reports and incidents forms. An Environmental Inspection Reports (EIR) is to be issued to Site Management when the Environmental Inspector identifies negative impacts, poor environmental practices and/or breach of the standards and its procedures. This is normally supported by photographic evidence.

NON-CONFORMANCE, CORRECTIVE AND PREVENTIVE ACTION

When procedures are not followed, action is taken to prevent the occurrence of environmental problems.

Non-conformances include breach of environmental legislation and failure to follow ESMP procedures. The Environmental Inspectors and EMU are to investigate the cause of non-conformance in order to determine appropriate corrective actions. Once and corrective actions are complete, the non-conformance is closed and no further action is required.

RECORDS

The Environmental Inspectors and EMU keep records of the documentation of the environmental inspection and monitoring. These records include:

- Environmental Inspection Reports;
- Monthly Environmental Summary;
- Environmental Incidents and any no-conformance reports;

- Corrective and preventive actions;
- Complaints;
- Permits and approvals;
- Employer/Consultant and EPC Contractor internal minutes of meeting; and
- Environment audit findings.

Records shall be kept to demonstrate the environmental performance at the site. This serves as a basis for interested parties to evaluate the site's performance. The records shall be legible, identifiable and accessible.

11.4.6 MONITORING FRAMEWORK

Effective monitoring of all stages of the project could be managed through an environmental management team. The principal aim of the environmental management team would be advising the project authorities and local administration about the best practicable means for protecting the environment during all stages of the project's life span.

It would provide the IPDC with proposals for monitoring the environment, and indicate operational procedures for protecting the environment.

The primary responsibility of this monitoring plan is of the IPDC who is the Project Developer. The Environmental monitoring plan will be administered within the IPDC project coordination office. The EMU will begin the implementation of the programme by forming a team of specialists to assist in monitoring the environmental effects during the construction period.

Independent external environmental monitoring may also be considered by MoEFCC for the activities that are not under the responsibility of the IPDC.

In addition, there are other agencies that have the responsibility and authority to monitor some of the measures. It is also recommended that the IPDC involves other Agencies (including MoEFCC) and subcontractors as required to form the environmental management team.

During the construction phase, the EPC contractor will designate an Environmental Inspector who will be responsible for environmental monitoring issues regarding the Project.

It is recommended that a formal annual audit of environmental and social performance is undertaken by an independent body.

Table 11-7: Monitoring Plan - Operation Phase

No.	Parameter to be monitored	Location	Measurement	Frequency	Institutional Responsibility	Cost (Birr)
1	Surface Water Quality	IAIP – Gidabo River - Upstream and downstream of the IAIP at 3 identified locations	Sampling and analysis Physical, chemical parameters	Monthly	IPDC/EMU	100,000 per year
		RTC – At the 3 surface water discharge points	Sampling and analysis Physical, chemical parameters	Monthly	IPDC/EMU	75,000 per year
2	Groundwater	Both up gradient and down gradient of the operations	Sampling and analysis Physical, chemical parameters	Quarterly	IPDC/EMU	100,000 per year
3	Air Quality	Sensitive receptors around the IAIP site	Observation and inspection / sampling and analysis	Quarterly	IPDC/EMU	200,000 per year
4	Noise	Sensitive receptors around the IAIP site	Portable sound level meter for measuring noise levels	Once a week and upon complaints	EPC Contractor, EMU	Equipment cost included in construction budget
5	Traffic	Access intersections at IAIP and RTC sites	Observation and reporting	Annual	IPDC/EMU	Covered in operation cost
6	Health and Safety	All work places	Visual inspection and reporting / Health and safety survey	Monthly	EMU	Covered in operation cost

No.	Parameter to be monitored	Location	Measurement	Frequency	Institutional Responsibility	Cost (Birr)
7	Environmental Monitoring Coordination	-	Monitoring of the implementation and success of the mitigation measures Reporting on monitoring results, and compliance with relevant legislation, contract and technical requirements	Monitoring continuously and Reporting bi-annually	EMU	Covered in operation cost
8	Resettlement and Socioeconomic	Monitoring of the Resettlement Action Plan (for details see RAP Report)				

11.5 PUBLIC CONSULTATION AND DISSEMINATION OF INFORMATION

Public Consultation was initiated in 2015 by the IPDC during the initial phase of the Project and continued in 2016 and 2017. The public consultation has been conducted to ensure that the project has taken full account of the priority concerns of PAPs and other relevant stakeholders in order to make the IPDC (the project developer) aware about the potential adverse impacts of the project and concerns raised by the stakeholders.

The FDRE Constitution, Article 92, states that; "*People have the right to full consultation and to the expression of their views in the planning and implementation of environmental policies and projects that affect them directly*".

Public consultations were held as part of the ESIA process with Federal, Regional, Zonal, Woreda and local officials and institutions, PAPs, community elders, etc. with the following key objectives among others:

- To develop and maintain avenues of communication between the project and stakeholders in order to ensure that their views and concerns are incorporated into the ESIA and associated management plans, with the objectives of reducing or offsetting negative impacts and enhancing benefits from the project;
- To inform and discuss about the nature and scale of adverse impacts and to identify and prioritise the remedial measures for the impacts in a more transparent and direct manner;
- Include the attitudes of the community and officials who will be affected by the project so that their views and proposals are mainstreamed to formulate mitigation and benefit enhancement measures;
- Increase public awareness and understanding of the project, and ensure its acceptance; and
- To inform local authorities of the impacts and solicit their views on the project and discuss their share of the responsibility

The stakeholder consultation process undertaken as part of the ESIA is discussed in Chapter 7.

A Stakeholder Engagement Plan (SEP) has been attached as **Appendix B** of the ESIA.

11.6 ORGANISATIONS AND INSTITUTIONS RESPONSIBLE FOR IMPLEMENTATION OF THE ESMP

11.6.1 INTER-ORGANISATIONAL COORDINATION

It is recognised that effective environmental management will only be achieved only if it is undertaken as a fully integrated part of the overall project management. In order to effectively implement a comprehensive environmental management plan, the coordination of efforts of the various Federal and Regional Agencies is necessary with a concept comprising three sub-components, namely:

- A clear framework of inter-organisational coordination measures;
- A specific information strategy; and
- A tailored capacity building program.

The key organisations for the implementation of the ESMP during the construction phase are the IPDC and EPC contractor. During the operation phase the IPDC is the major responsible agency. There are other government agencies which will have the responsibility for implementation of certain mitigation and monitoring activities and their activities will be coordinated by the IPDC.

The main responsible institutions for implementation, coordination and administration of the Environmental management plan set out in this ESMP is summarised in **Table 11-8**.

Table 11-8: Main responsible institutions for implementation of the ESMP

Organisation	Role	Construction	Operation	Responsibility in ESMP
IPDC	Project Developer and Agency responsible for operating the IAIP and RTC	✓	✓	Implementation of RAP Coordination with other agencies Monitoring During operation phase responsible for the IAIP and RTC
EPC Contractor	Construction activities	✓		Implementation of mitigation measures Monitoring (For the construction phases)
MEFCC	Agency responsible for monitoring / auditing of environmental pollution	✓	✓	Monitoring/ auditing for compliance with Federal and Regional Environmental Regulations
Ministry of Health and Regional Health Bureau	Agency responsible for public health	✓	✓	Monitoring public health
Ministry of Labour and Social Security	Agency responsible for occupational health	✓	✓	Monitoring / auditing
IPDC and Federal Government	Agency responsible for resettlement and construction of relocation sites	✓	✓	Implementation of RAP Monitoring of compensated families

11.6.2 IPDC ENVIRONMENTAL MONITORING UNIT

The main responsibilities of the Environmental Monitoring Unit (EMU) include:

- Review and approve of the environmental components of the EPC contractor's project plan.
- Ensure that mitigation measures, conditions and specifications are fully implemented during construction and resolving problems as encountered.
- Supervise restoration of construction area that was affected during construction period of the project to its natural state.
- Conducting periodic environmental monitoring during construction and operation phases.
- Monitoring proper implementation during resettlement and post resettlement of communities.

- Liaise with members of the public, local organizations, government and non-governmental organizations; and,
- Report results of mitigation and monitoring activities to the MEFCC, Regional Environmental offices and other relevant parties.

11.6.3 MINISTRY OF ENVIRNMENT FORESTY AND CLIMATE CHANGE

As per Proclamation 803/2013 (amendment), the Ministry of Environment, Forestry and Climate Change (MEFCC) has the powers and duties to:

- Coordinate measures to ensure that the environmental objectives provided under the Constitution and the basic principles set out in the Environmental Policy of Ethiopia are realised.
- Establish a system for environmental impact assessment of public and private projects, as well as social and economic development policies, strategies, laws and programmes.
- Establish a system for the evaluation of the environmental impact assessment of investment projects submitted by their respective proponents by the concerned sectorial licensing organ prior to granting a permission for their implementation in accordance with the Environmental Impact Assessment Proclamation.

Article 24(2) of the Industrial Park Proclamation No. 886/2014 requires the MEFCC to establish offices within the industrial parks for the application, supervision, protection and enforcement of environmental norms and standards, safeguards, management and mitigation plans within the industrial parks.

11.6.4 EPC CONTRACTOR

The EPC contractor will assign an Environmental Inspector during the construction phase. The Environmental Inspector is responsible to:

- Check compliance with recommended conditions in the contract, ESIA and ESMP;
- Review the effectiveness of mitigation measures for proper management of construction risks and uncertainties;
- Review the effectiveness of environmental management plan for the construction activities.
- Recommend modifying or halting construction activities, or developing appropriate mitigation measures in case of unpredicted adverse effects on the environment or if environmental monitoring determine construction works pose environmental concern;
- Identify and liaise to promote social integration and the development of mutually satisfactory solutions to problems affecting local communities; and
- Provide advice and assistance, as and when required, on aspects of environmental management.

11.7 REPORTING AND REVIEWING

11.7.1 GENERAL

The management measures identified in the ESMP concern actions to be taken in order to prevent, or mitigate, environmental or social impacts, or to enhance positive impacts. A system of reporting and auditing of the ESMP commitments is required to assess the degree of success in terms of implementation of the ESMP. This will apply to IPDC and the EPC Contractor.

The expected reports include:

- Site Environmental Management Plan,
- Site Inspection and
- Progress Reports.

Each of these organisations will provide monthly reports on the actions taken in the previous month to fulfil the ESMP. The IPDC will be able to draw on the reports it receives from the contractor and augments these reports with a report of its own performance.

A complete set up to handle and manage data and information generated from the management plan and other monitoring activities will be established. Therefore, the EMU shall maintain all necessary records related to environmental management and monitoring.

The MEFCC will be required to randomly verify the actual performance of the EPC Contractor and the EMU Team.

It is recommended that a formal annual audit of environmental and social performance be carried out by an independent entity.

11.7.2 RECORD KEEPING AND REPORTING

Records of significant environmental matters, including monitoring data, accidents and occupational illness, and spills, fires and other emergencies shall be maintained.

Recorded information shall be reviewed and evaluated to improve the effectiveness of the ESMP. An annual summary of the above information shall be provided to statutory authorities, if required.

11.8 PROJECT FEEDBACK ADJUSTMENT

11.8.1 PROJECT FEEDBACK

The monitoring programme will establish effective feedback mechanisms so that the performance and effectiveness of the various elements of the ESMP can be evaluated, and if necessary corrective actions can be implemented.

The monitoring results as well as the report on environmental performance and the occurrences of unforeseen circumstance may also be used to modify and reshape the project’s construction methods and/or operation.

The ESMP is to be available at the project offices for all employees of the project.

11.8.2 AMENDING THE ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN

The ESMP has been developed with project knowledge and information available to-date. As project scheduling plans are developed and changed, and construction techniques determined, components of the ESMP might require amending.

The IPDC may periodically revise the ESMP in consultation with the EPC Contractor, and subject to approval from the MEFCC, to accommodate changes in work and site conditions.

11.8.3 CHANGE MANAGEMENT

The ESMP is a working document that changes during the life of the project. Therefore, in the event that compliance regarding environmental requirements is determined to be inadequate, or to address unforeseen or unexpected conditions, changes to project design, procedures, process or activities can be proposed at any time during the project. Should the environmental monitoring also determine construction works or operation pose an environmental concern, the works or operation will be modified or changed to adopt mitigation measures to changing situations throughout the project construction and operation phases.

The EMU is responsible to ensure operations are conducted as recommended in the ESMP and in accordance with statutory requirements and recommends any necessary changes to the plan. The change management processes include the following:

- Identification of item/situations potentially requiring change;
- List and document the reason for making changes to ESMP;
- Preparation of change request document that:
  - outlines the nature of the item/situation requiring change,
  - outlines impacts of the change (cost, schedule, safety, operability, etc.), and
  - identifies potential biophysical, socio-economic or health concerns.
- Review of the proposed changes to ensure that environmental protection measures will be adopted and the proposal provides an acceptable level of impact control;
- Documentation of the approval or rejection of the change request;
- Implementation of the approved change, including communication to appropriate parties concerning the nature, scope and timing of the change; and
- Summary of project changes and status to be included in the monthly reports and the annual environmental status report.

When a procedure is amended to suit a particular type of environment, both the IPDC and the EPC contractor are responsible for managing changes within their respective areas of responsibility. The EPC contractor is responsible for ensuring that construction staff are aware of any changes to the ESMP and revised procedures.

11.9 CONTINGENCY PLANS

The IPDC is to develop a contingency plan which is designed to take account of a possible future events or circumstance including accidents, fires, hazardous spills, natural disasters that may affect the IAIP and RTC facilities.

The IPDC are to ensure that each facility develops a site specific contingency plan for each development with the parks.

These plans are to be reviewed and updated on an annual basis.

11.10 PROJECT GRIEVANCE AND REDRESS MECHANISM

11.10.1 OS REQUIREMENT ON GRMS

In OS 1, the AfDB requires the establishment of a "*credible, independent and empowered local grievance and redress mechanism to receive, facilitate and follow up on the resolution of the affected people's grievances and concerns regarding the environmental and social performance of the project. The local grievance mechanism needs to be sufficiently independent, empowered and accessible to the stakeholders at all times during project cycle and all responses to grievances shall be recorded and included in project supervision formats and reports*."

The aim of a project Grievance and Redress Mechanism (GRM) is therefore to enable people fearing or suffering adverse impacts to be able to be heard and assisted.

11.10.2 OBJECTIVES AND SCOPE OF A GRM

A project GRM is a systematic process for receiving, evaluating and facilitating resolution of affected people's project-related concerns, complaints and grievances about the borrower's/client's social and environmental performance on a project.

The GRM provides a structured and managed way of allowing the concerns of affected people to be heard and addressed.

11.10.3 DEVELOPING AND IMPLEMENTING A GRM

DEVELOPING A GRM

The process by which a complaint will be accepted or rejected needs to be carefully designed, and should maximise interactivity and cultural sensitivity. The acceptance/rejection of a complaint should go through a discussion stage where the plaintiff and the GRM staff interact on the grounds and motives of the complaint, after which the plaintiff should clearly and transparently be told whether or not the complaint is eligible and will be processed. It is best if the acceptance/rejection of the complaint is based on objective criteria that are posted by the GRM, including a written copy displayed in the public access area of the GRM in an appropriate language.

The processing of the complaint, if accepted should go through various phases:

- Filing of the complaint and labelling with an identification code, communicated immediately to the plaintiff.
- Assessment of the complaint (including severity of the risk/impact).
- Formulation of the response.
- Selection of the grievance resolution approach is key. There are four general approaches to choose from:
  - The project's management proposes a solution.
  - The community and the project's management decide together.
  - The project's management and the community defer to a third party to decide.
  - The project's management and the community utilise traditional or customary practices to reach a solution.

"*Decide together*" approaches are usually the most accessible, natural and unthreatening ways for communities and a project's management to resolve differences. With the potential to resolve perhaps the majority of all grievances, "*decide together*" should be the centrepiece of any grievance mechanism's resolution options.

The relevant GRM is to be developed in line with Section 7 of the Industrial Parks Council of Ministers Regulations No. 417/2017.

IMPLEMENTING A GRM

During project implementation, five steps may be required:

- Establish human resources and logistics.
- Introduce the GRM to project staff.
- Communicate with the local communities to build awareness.
- Train and support participants.
- Develop a monitoring programme.

An internal communication campaign among the key project staff should highlight that the function of the GRM is not to put blame on individuals or to identify mistakes and other errors, but rather that it identifies the risk of unintended negative impacts so as to avoid them altogether or, at worst, to compensate for them if intervention/warning comes too late.

Effective communication also needs to be established with the community itself to explain that the GRM, what the goals and roles of the GRM are and how GRM intervention can or should be triggered.

This effort should follow these key principles:

- Develop simple, visually engaging marketing materials;
- Provide materials in an understandable format and language; and
- Use face-to-face, informal meetings in local communities.

Finally an important element of implementation is monitoring and reporting, including evaluating success and identifying need for improvement.

Refer to **Appendix B** (Stakeholder Engagement Plan) of the ESIA for Grievance Mechanism Process.

11.10.4 LOCAL COMMUNITIES

The IPDC and the EPC contractor should be prepared to respond to the communities, concerns related Project. A grievance mechanism is proposed to be established to receive and facilitate resolution of the affected communities concerns. Liaison groups significantly reduce the aggravation and hostility of locals to the IPDC and the EPC contractor and their staff.

During construction phase, it is recommended that a community Liaison group be established. Therefore, both the IPDC and the EPC contractor should assign the responsibility of liaising with local communities and local authorities to their respective Community Development and Liaison (CDL) Officer. The CDL will be permanently on site and will provide effective liaison to promote social integration, and the development of mutually satisfactory solutions to problems affecting local communities.

Regular interaction with local communities by the CDL will ensure that many problems are dealt with at an early stage and effectively. Both the IPDC and the EPC contractor's PRs will be available to deal with issues arising out of construction sites. Therefore, it is recommended that the CDL be allocated an office at both sites.

Any aggrieved local residents can bring their grievance to the IPDC or the EPC contractor at any reasonable time and the matter will be discussed and dealt with in appropriate manner. The grievances shall be addressed promptly, using an understandable and transparent process, which shall be readily accessible to all segments of the neighbouring communities.

Complaints shall be resolved through negotiations with the community. In the negotiation it is recommended to involve existing community institutions like the Kebeles and others community leaders.

Appropriate public addressing systems shall be used as well as other means to announce certain events, such as programmed hours of explosions (if applicable) during construction, hazardous activities for the people to be aware of, closure of roads for certain hours due to construction activities, etc.

This office will deal with the day-to-day information needs of the local people. Furthermore, provision of information regarding the project shall circulate to the local population through their leaders.

11.10.5 CONSTRUCTION WORKERS

The EPC contractor shall develop a grievance mechanism for workers and their organizations to raise reasonable workplace concerns. The mechanism will involve an appropriate level of management and address concerns promptly, using a transparent process.

11.11 TRAINING AND CAPACITY BUILDING

If the environmental management and monitoring programme is to be successfully implemented it is recommended that a various training be provided. In general, training should be composed of workshops, in-service training, and in-service formal courses.

11.11.1 IPDC

IN-SERVICE TRAINING AND TECHNICAL ASSISTANCE

The technical assistance will facilitate adequate on-the-job training and technology transfer, enabling the EMU staff to undertake their monitoring activities during the Construction and Operation Phases of the Project.

The Technical Assistance Project will have the following overall aims:

- To help the EMU to implement the core obligations with respect to the Environmental Measures, including the continuous review of the ESMP;
- To help the EMU to monitor all obligations with respect to the environmental measures;
- To provide on-the-job training to EMU staff as well as the employees of the consultants involved in various activities. They shall participate in environmental awareness training seminars and workshops This will help to build technical expertise in the environmental and social aspects of the Project;
- To assist the EMU to coordinate its work with other government authorities and non-government agencies concerned with the Environmental Objectives; and
- To instruct EMU staffs in the proper techniques of Project inspection, monitoring, use of field monitoring equipment, data analysis and reporting.

It is proposed that the training should be aimed at IPDC personnel and in particular, the staff members of the EMU. Training arrangements would need to be discussed in detail with the IPDC to establish precise objectives and requirements, so that the course content can be specifically targeted at real needs.

11.11.2 OTHER FEDERAL AND REGIONAL LEVEL AGENCIES

In an effort to strengthen institutional capacity and environmental awareness, seminars and workshops to be organised under this project should also be open for individuals from concerned ministries and agencies such as the MEFCC, SNNP's office of Environmental Protection, the Regional Bureau of Agriculture and Rural Development, Regional and Woreda level Environment departments, etc. The objectives of the seminar-workshops are to ensure environmental awareness, knowledge and skill for the implementation of this ESMP.

11.11.3 TRAINING CONSTRUCTION WORKERS

The foremen, operators, and work crews (including any subcontractors) will be trained so that they understand the specific environmental issues on the work site and their responsibilities. All personnel are to receive a brief environmental and safety training course.

LOCAL RECRUITMENT PLAN

Condition 28(1) of the Industrial Park Proclamation No. 886/2015 states that the Labour Proclamation No. 377/2003 (as amended) is applicable in any Industrial Park. Additional condition 28(4) indicates that the Ministry of Industry shall organise technical and vocational training programs in collaboration with the concern government entities and IPDC whenever necessary.

A Local Recruitment Plan is to be prepared for both the construction and operations phases, aimed at maximising employment opportunities for the PAPs and local communities and to manage expectations and the potential for influx into the area during the construction and operation phase of the Project. The Plan is to take into account vulnerable groups such as women, youth and Project PAPs.

The Plan is to include details for job training and capacity building prior to and during the construction and operation activities. The Plan is to also include procedural guidelines and a code of conduct concerning employment and workforce in order to encourage appropriate work ethics and behaviour.

This is particularly important where employment opportunities will be realised by individuals outside of the Project area.

Finally, this Plan is to include an on-going communication strategy to clearly and consistently disclose information regarding employment opportunities and contracting procedures, with the idea of managing expectations of job opportunities, and therefore influx of workers. Key messages may include the number of positions available, the timeframe for employment availability, and an explanation of the contracting process.

Influx management will also involve a coordinated approach which key stakeholders with responsibility for issues related to influx, including governmental offices and agencies, NGOs, and local communities, where relevant.

HEALTH AND SAFETY PLAN

To address both occupational and community health and safety risks, a Health and Safety (H&S) Plan is to be prepared for both the construction and operations phases. It is to include a company policy, and measures included within are to comply with national laws and the AFDB ISS. Aspects to be covered in this Plan include:

- Health and safety training for all employees;
- Health and safety training on the use of chemical and hazardous materials;
- Provision of the appropriate Personal Protective Equipment (PPE);
- Traffic management plan and driver training;
- Accident prevention monitoring;
- Training in the use of all equipment;
- Safeguards of environmental pollution of water resources;
- Safeguards in hazardous materials handling and transportation;
- First Aid access and communications; and
- Emergency Response Procedures.

In addition, health education with regard to communicable diseases is to be undertaken as part of the induction training for workforce members. This is to include health education on sexually transmitted diseases (STDs) as well as diseases such as malaria.

Provision is to be made for education awareness of communicable diseases within the wider community. If possible, this is to be undertaken in collaboration with NGOs relevant to health care, and the local administration.

COMMITMENT TO WORKERS' RIGHTS

The Project needs to ensure its policy and procedural consistency with international standards related to workers' rights. This includes:

- Observing statutory requirements relating to minimum age for employment of children and meeting international standards of not employing any persons under the age of 14 for general work and no persons under the age of 18 for work involving hazardous activity.
- Ensuring acceptable conditions of work including observing national statutory requirements related to minimum wages and hours of work.
- Meeting international standards related to paying all wages, including bonuses and premium pay for overtime work, to all employees in a timely fashion and in a manner consistent with ILO Convention 95.
- There should be clearly benchmarked payment schedules in the Contractors" contracts.
- Having Contractors commit that they will not take any action to prevent employees from exercising their right of association and their right to organise and bargain collectively.
- Ensuring no workers are charged fees to gain employment on the Project.
- Ensuring rigorous standards for occupational health and safety are in place.

- Having Contractors base employment decisions on principles of non-discrimination and equal opportunity, in particular fair and equal pay, especially for women carrying out the same work as men.
- Having Contractors establish a labour grievance mechanism and documenting its use for complaints about unfair treatment or unsafe living or working conditions without reprisal. Access to labour grievance mechanisms needs to stress its relevance for both genders.

As emphasised above, these commitments need to be passed on to Contractors and Sub-contractors via main and subcontract clauses, and requirements to address them in management systems and work procedures.

PROJECT CODE OF CONDUCT

It is recommended that the Project establish a Code of Conduct for the labour force. The Code of Conduct recognises the provision of resources by the employer and shares responsibilities among the workers for the use of equipment, procedures and training. It aims to contribute to a harmonious relationship with local communities, to reduce behaviours that could lead to social conflict, and to prevent further environmental degradation.

Typical issues to be addressed would include:

- Proper use of PPE and other work equipment that has been provided;
- Discreet sexual behaviour that takes into consideration messages about HIV/AIDs sexually transmitted diseases;
- Restrictions related to consumption of alcohol and drugs;
- Respect for the local community and its cultural norms in which labourers are working; and
- Professional behaviour and integrity when dealing with the public.

11.12 ANNEXURES

ANNEXURE 11.1

Air Quality - Recommended mitigation measures for general construction (USEPA, 1995).

Recommended Air Quality mitigation measures for general construction (USEPA, 1995).

Emission Source	Recommended Control Method
Debris handling	Wind speed reduction
	Wet suppression[(1)]
Truck transport[(2)]	Wet suppression
	Paving
	Chemical stabilisation[(3)]
Bulldozers	Wet suppression[(4)]
Pan scrapers	Wet suppression
Cut/fill material handling	Wind speed reduction
	Wet suppression
Cut/fill haulage	Wet suppression
	Paving
	Chemical stabilisation
General construction	Wind speed reduction

Emission Source	Recommended Control Method
	Wet suppression
	Early paving of permanent roads

Notes:
(1) Dust control plans should contain precautions against watering programs that confound trackout problems.
(2) Loads could be covered to avoid loss of material in transport, especially if material is transported offsite.
(3) Chemical stabilisation usually cost-effective for relatively long-term or semi-permanent unpaved roads
(4) Excavated materials may already be moist and may not require additional wetting.

ANNEXURE 11.2

Air Quality - Recommendations to reduce emissions from identified sources during the operational phase.

Recommended Air Quality mitigation measures for the operational phase.

Source	Recommendations for Mitigation
Boiler	• Emissions from the boiler should be compliant with the IFC EHS emission guidelines for small combustion processes (defined as systems designed to delivery electrical or mechanical power, steam, heat or any combination of these, regardless of the fuel type, with a total, rated heat input capacity of between three MW and 50 MW). These emission guidelines are applicable to small combustion process installations operating more than 500 hours per year, and those with an annual capacity utilisation of more than 30%; • Annual stack testing is also recommended to be undertaken for SO_2, NO_x and PM. If the annual stack emission testing results show constantly (3 consecutive years) and significantly (less than 75%) better than the required levels, the frequency of the annual stack emission testing can be reduced from annual to every two to three years.
Brewery	• To reduce emissions from wort boiling, a heat recovery system should be used to collect and condense the vapours and the recovered energy used in process or utility systems; • Cyclones and bag filters should be used to collect and recover dust in the following manner: - Dust generated from the unloading of raw materials and transport of malt and adjuncts should be conveyed to the mash or adjunct kettle and the extract recovered; - Dust arising from malt and adjuncts may be used as animal feed.
Dairy Processing	• Installation of exhaust ventilation equipment equipped with dry powder retention systems (e.g. cyclones or bag filters) to reduce dust emissions; • Ensure wastewater treatment facilities are properly designed and maintained for the anticipated wastewater load; • Keep all working and storage areas clean; • Empty and clean the fat trap frequently;

Source	Recommendations for Mitigation
	• Minimise stock of waste and by-products and store for short periods in cold, closed and well ventilated rooms; • Enclose production activities that cause odour and operate under vacuum.
Food and Beverage Processing	• Cover skips, vessels and stockpiles; • Enclose silos and containers used for bulk storage of powders and fine materials • Where enclosure is not feasible, use sprays, windbreaks, sweeping, sprinkling and other stockpile management techniques; • Use closed conveyers equipped with filters to clean transport air prior to release; • Use cyclones, venture scrubbers, ESPs to remove particulate matter from the gas stream (where feasible); • Recirculate exhaust gas from frying and other cooking operations to the burner; • Minimise storage duration for solid waste to avoid putrefaction; • Operate facilities under partial vacuum to prevent fugitive odour emissions; • Regular inspection of chilling and freezing equipment to monitor loss of refrigerants.
Meat Processing	• Pasteurize organic matter before processing it to halt biological processes that generate odour; • Install rendering equipment in closed spaces and operate under negative pressure compared to ambient air conditions; • Minimize the inventory of raw carcasses, waste and by-products and stored it for short periods of time in a cold, closed, well ventilated place; • Seal off animal by-products during transport, loading, unloading and storage activities; • Clean pens and livestock yards on a timeously basis; • Empty and clean fat traps frequently; • Add oxidants such as nitrates to stored waste and effluent; • Unload contains containing animal by-products within an enclosed building that is equipped with extraction ventilation connected to odour abatement devices; • Clean and maintain a sufficient level of humidity in pens and livestock yards to reduce dust/particulates; • Reduce fugitive dust by minimising surface areas with exposed soil surfaces, and by planting hedges or erecting fences to minimise wind turbulence; • Use liquefied petroleum gas or natural gas instead of fuel oil in the singeing process.
Sewage Treatment Works	Basic means of odour control that should be undertaken at sewage treatment works include (DEFRA, 2006): • Good housekeeping and raw materials handling practices; • Control and minimisation of odours from residual materials and waste;

Source	Recommendations for Mitigation
	• Maintaining the effluent aeration other than in processes which are specifically anaerobic; • Avoiding anaerobic conditions; • Minimising septicity; • Selecting process steps that present least risk of odour.
Vehicle entrainment on paved roads	• Dust emissions from paved roads vary with the silt loading present on the road surface, as well as the average weight and speed of vehicles travelling on the road. • As the silt loading of the road is a significant determinant of dust emissions, control techniques attempt to either prevent material from being deposited onto the surface (preventive controls) or to remove from the travel lanes any material that has been deposited (mitigative controls). • Preventative measures include the covering of loads in trucks and the paving of access areas while mitigative measures include vacuum sweeping, water flushing, and broom sweeping and flushing (USEPA, 2011).
Vehicle entrainment on unpaved roads	• Vehicle restrictions that limit the speed, weight or number of vehicles on the road; • Surface improvement by measures such as paving or adding gravel or slag to a dirt road; • Surface treatment such as watering or treatment with chemical dust suppressants.

12 CONCLUSIONS

This ESIA has been undertaken in accordance with Ethiopian Legislation and the African Development Bank (AfDB) Operating Safeguards. Chapter 1 of this ESIA includes a summary of the contents of each chapter that is required in order for the ESIA to meet the AfDB requirements.

The scoping stage of the ESIA identified the need to consider potential impacts during the construction and operational phases of the Project on: soils, surface water, ground water, wetlands, air quality, climate change, noise, transport and access, waste management, visual impacts, biodiversity and socio-economic environments on the functionality of the Project.

The majority of impacts were assessed to be of minor negative significance with mitigation. The moderate residual negative effects of the project arise from the risk of soil erosion, sedimentation, soil compaction, hydrological functioning modifications, and degradation of noise climate during construction and decommissioning. These impacts are anticipated to occur predominantly during the construction period but all will be removed during operation. Ongoing monitoring of surface and groundwater will ensure these impacts do not occur and when identified can be dealt with in a timely manner. Therefore these impacts are deemed appropriate for the size and extend of the project proposed and are acceptable impacts of construction which if managed well can be minimised. The remaining moderate impact relate to loss of access to agricultural land plots and in some cases, loss of residential buildings, other assets (crops) and cultural heritage resources (churches and graves). These impacts have occurred as a result of the proposed site supporting existing agricultural practices. These impacts are being mitigated through payment of compensation, access to training and reallocation of land. The SNNP Resettlement Action Plan (RAP) deals with these issues and others and will be a live document that will be implemented post authorisation. In addition the Stakeholder Engagement Plan (Appendix B1) contains a summary of consultation completed to date as well as the consultation that should occur into the Project Execution phase. Further moderate negative impacts relate to the potential for the workforce to introduce and increase the rate of spread of communicable diseases in the project area.

The major negative impacts identified relate to change in surface profile, compaction, land use and land capability, direct loss/degradation of natural wetland habitat and biota. These impacts are expected and irreversible following development but are considered acceptable consequences of a transformation project such as this. In addition, the anticipated significant negative impact identified in relation to the potential lack of jobs in the event that the IAIP is decommissioned, highlights the value the employment opportunities being offered by this project are to the economy and the local communities. There will be a negative impact on the livelihoods of the local community gaining employment from the facility.

The major and moderate residual positive effects of the project arise from the creation and management of artificial wetland habitats within the IAIP to mitigate for the removal of existing surface water dams on the site. In addition, the proposals seek to re-vegetate the greenery areas with indigenous plant species. The presence of the IAIP and RTC sites within the context of the surroundings is considered to present a positive visual enhancement to the area. The park is seen as representing progression and advancement in the agricultural sector through industrialisation. Overall the community consultation process undertaken as part of this ESIA has shown an overwhelming support of the SNNP Regional project even by the project affected people. The community believe that a development of this scale and magnitude, offering large employment opportunities will uplift the whole community.

A number of measures have been identified as necessary to minimize and control the risk of erosion and water pollution to surrounding water resources. Water use and pollution would need to be monitored in the future to limit residual effects on other water users and ecosystems in the Project area.

Based on the census data collected by the IPDC, the proposed SNNP Project (including the IAIP and RTC facilities) will result in 229 PAPs being affected by a combination of economic and physical displacement, 176 PAPs being economically displaced, 18 PAPs being physically displaced, and 44 PAPs being affected where their familial graves will need to be moved, resulting in a total 467 PAPs.

The relocation and compensation process is underway. A Resettlement Action Plan has been developed as part of the Project, which focuses on displacement issues in more detail.

The project also has a number of broader benefits that have been identified, mainly associated with economic well-being of the local communities. The industrialisation of the agricultural sector provides employment transition opportunities for farmers and their children. The Yirga Alem IAIP and Dilla RTC are anticipated to increase incomes, provide greater food security and more employment opportunities.

The Stakeholder Engagement process as part of the Project has been summarised in Chapter 7 of this ESIA and the Stakeholder Engagement Plan (SEP) is included as **Appendix B-1**. The Stakeholder Engagement built on the existing work done by the local authority and has further established links with representatives for stakeholder groups; facilitated data collection; identified concerns and opportunities.

An Environment and Social Management Plan (ESMP) has been developed (Chapter 11). The ESMP represents the SNNP IPDCs commitment to address and manage the potential negative and positive impacts associated with the Yirga Alem IAIP and Dilla RTC projects. The key intent of the ESMP is to ensure that the environmental and social objectives of the project are met and it is based on the various components of the Project throughout design, construction and operational phases.

The ESIA has not identified any fatal flaws which would restrict the development of the proposed SNNP IAIP and RTC.

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APPENDIX

A

MEFCC CERTIFICATES FOR ETWRDEC

APPENDIX

B

STAKEHOLDER CONSULTATION

APPENDIX

B-1 *STAKEHOLDER ENGAGEMENT PLAN*

APPENDIX

B-2 *STAKEHOLDER ENGAGEMENT MINUTES – SCOPING PHASE*

APPENDIX

B-3 *STAKEHOLDER ENGAGEMENT MINUTES – ESIA PHASE*

APPENDIX

C SPECIALIST REPORTS

APPENDIX

C-1 SOILS

APPENDIX

C-2 SURFACE WATER

APPENDIX

C-3 GROUNDWATER

APPENDIX

C-4 *WETLANDS*

APPENDIX

C-5 AIR QUALITY

APPENDIX

C-6 CLIMATE CHANGE

C-7 NOISE

C-8 TRANSPORT AND ACCESS

APPENDIX

C-9 *WASTE MANAGEMENT PLAN*

C-10 VISUAL

APPENDIX

C-11 *BIODIVERISTY*

APPENDIX

C-12 SOCIO-ECONOMIC

APPENDIX

C-13 CULTURAL HERITAGE

APPENDIX

D

ESIA CONSOLIDATED IMPACT SIGNIFICANT MATRIX