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ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT REPORT

FOR THE PROPOSED BAEKER IAIP AND MAI KADRA RTC

ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT
WESTERN TIGRAY REGION, ETHIOPIA

March 2018

Report produced by:
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In collaboration with WSP/UNOPS

On behalf of:
UNIDO and Tigray Industrial Parks Development Corporation, Federal Democratic Republic of Ethiopia

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ESIA REPORT

FOR THE PROPOSED BAEKER IAIP AND MAI KADRA RTC

ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT

WESTERN TIGRAY REGION, ETHIOPIA

Tigray Region IPDC

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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
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
MEFCC	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
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
WASH	National Water Supply, Sanitation and Hygiene
WBG	World Bank Group
WMS	Welfare Monitoring Survey
WRB	World Reference Base Classification System

WSP	WSP Environment and Energy, Africa.
ZGEC	Zereu Girmay Environmental Consultancy

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 (after Nigeria which has a population of approximately 186 million people, 2016 estimates) with a population of over 100 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 regional 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 Tigray Region) 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 supports a 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.

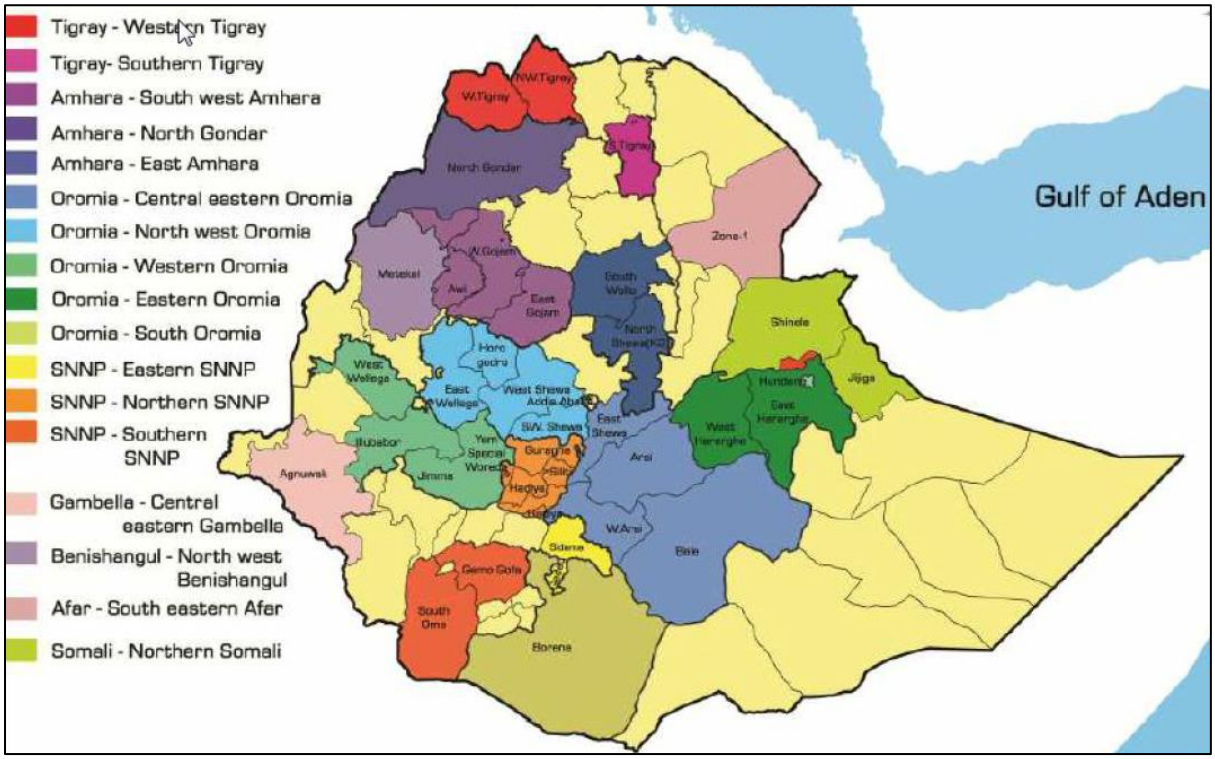

Figure 1-1: Potential Agro Commodities Processing Zones (Source: MACE)

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.

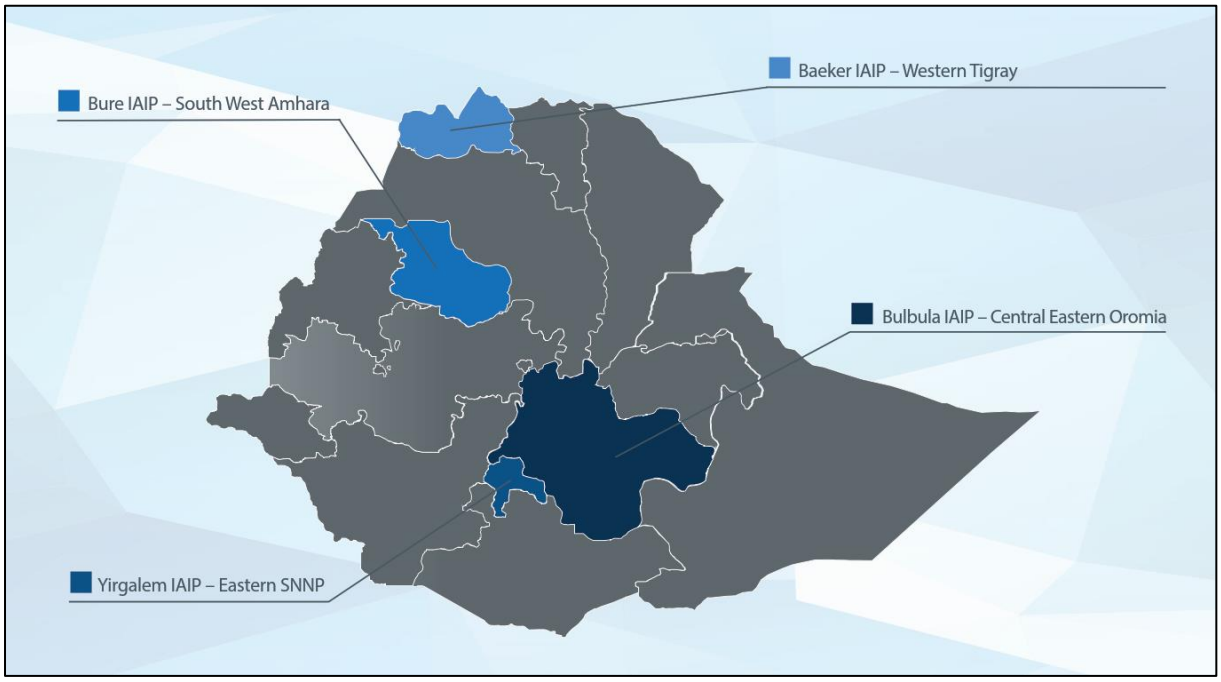

Figure 1-2: The four ACPZs selected for pilot facilities (Source: MACE)

This ESIA report relates to Western Tigray Baeker ACPZ facilities as identified in **Table 1-1**.

Table 1-1: ACPZs selected and associated piloting facilities

Region	IAIP Location	RTC Location
Western Tigray Region	Baeker	Mai Kadra

The proposed Baeker IAIP site is located within the Tigray Region, which is the northernmost of the nine regions of Ethiopia. Tigray is known as Region 1 according to the constitution provisions established by the FDRE in 1995. Its capital and largest city is Mekele. The Tigray Region includes seven administrative zones, namely; the Southern Admin Zone, Eastern Admin Zone, South-East Admin Zone, Mekelle Admin Zone, Central Admin Zone, Western Admin Zone and North-west Admin Zone. The project area falls within the Western Admin Zone in the Kafta Humera Woreda which covers both Baeker and Mai Kadra towns (see **Figure 1-3** below for further details of the project area location). As the IAIP and RTC sites are located in Baeker and Mai Kadra towns respectively, the Project area is in close proximity to the Eritrean and Sudanese Borders.

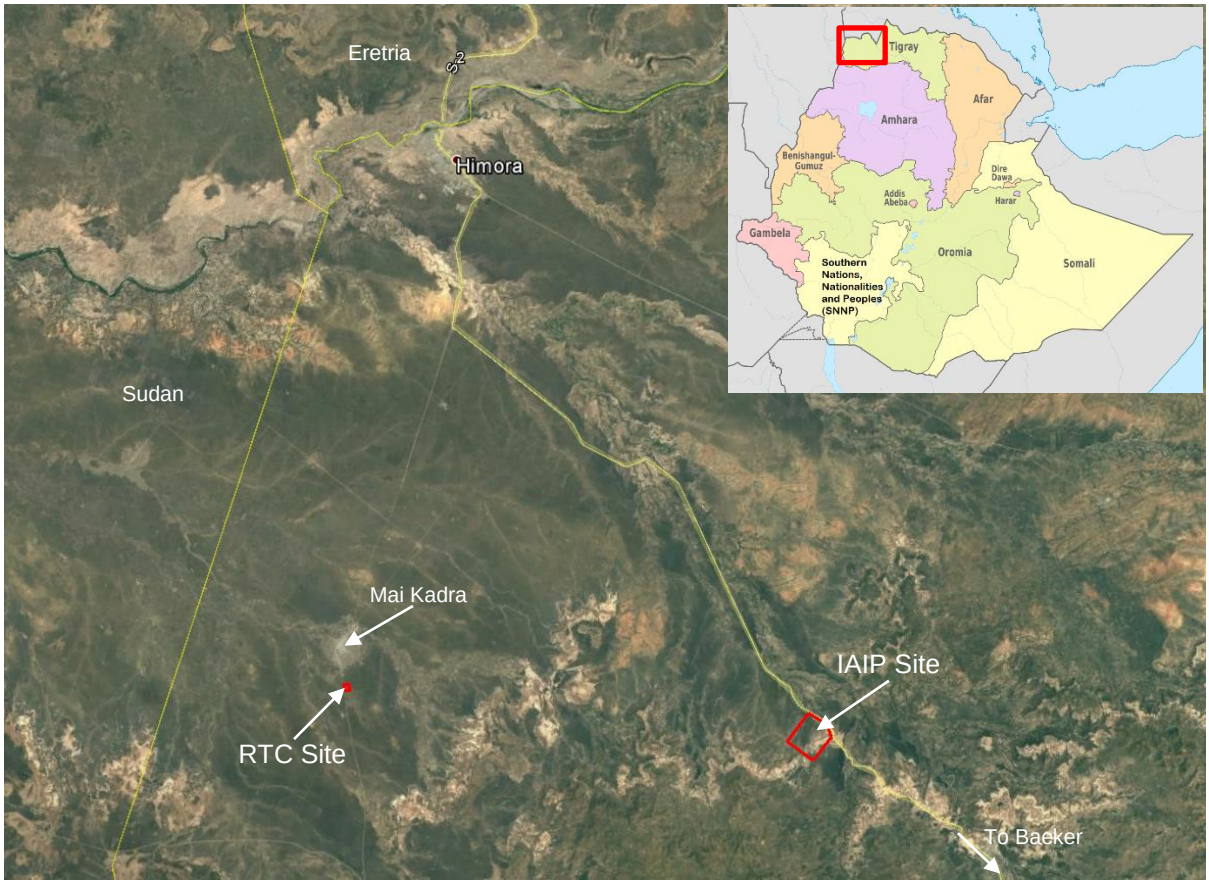

Figure 1-3: Layout showing the administrative map of the Regions and location of the Baeker IAIP and Mai Kadra RTC sites in the Western Tigray Region (Source: Google Earth)

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 (MEFCC) 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, Zereu Girmay Environmental Consultancy (ZGEC), in collaboration with WSP, Environment & Energy, Africa, have been appointed to undertake the required ESIA for the proposed Baeker IAIP and associated Mai Kadra RTC within the Western Tigray 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 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 parties establishing this infrastructure.

1.2 LAND TENURE AND LAND USE

In Ethiopia all land belongs to the State and people; 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. Unlike the rest of the country, the Tigray regional state has a gender-progressive land proclamation and progressively implements it. Here, land registration took place very early and both husbands and wives have equal rights to land: land is registered under both of their names and upon separation and dissolution of marriage; they take away equal shares of the land. However, this depends on communities, as some local communities practice polygamy, and in such families the names of the husband and his first wife are often recorded in the land certificate (USAID, 2013).

Tigray, the northernmost region in Ethiopia, is most known for its serious land degradation problems. Much of the woodland in Tigray started to disappear in the early 1960s under pressure from the rapidly growing population. In the region, a short and variable rainy season in combination with degraded soils resulted in low soil productivity and frequent crop failures. As a result, the local population is structurally dependent on food aid.

In the last two decades, farmers in Tigray made significant environmental rehabilitation efforts. Among the recent efforts towards enhancing agricultural development in the region, rainwater harvesting has been widely adopted because supplementary irrigation is essential for crop production during dry seasons (Gelaw *et al*., 2015).

The Regional land use and land cover details are presented in **Table 1-2**.

Table 1-2: Regional Data - Land use and land cover type

No.	Land use/Land cover Type	Spatial Coverage in	
		Area (ha)	Percentage (%)
1	Cultivated Land	1,434,792	28.21
2	Grassland	1,158,681	22.78
3	Bush and shrub land	1,840,918	36.20
4	Woodland	295,082	5.80
5	Natural forest	9.407	0.18
6	Afro alpine land	670	0.02
7	Exposed rocks and soil	335,569	6.60
8	Water bodies and wetlands	8,053	0.16
9	Urban development	2,610	0.05
	TOTAL	**5,085782**	**100.00**

Source: Ministry of Agriculture and Natural Resources

In Tigray, agriculture contributes around 57% to the regional GDP, of which 36% is from crop production and about 17% and 4% is from livestock and forestry respectively (BPED, 2011). Rain-fed crop production is the main economic activity for over 85% of the population, supplemented by livestock rearing under mixed-subsistence systems. The average land holding in the highlands of the region is less than a hectare. The main crops cultivated in the region are wheat and barley. Small amounts of teff and lentils are produced to supplement income. The decision to grow short cycle crops is to some extent influenced by the unreliable rainy season.

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 will:

- Meet the requirements of the Ethiopian EIA regulations;
- Meet the requirements of the AfDB Operating safeguards;
- Provide input into the Project Engineering Team to ensure that the design minimises environmental and socioeconomic impacts and maximises sustainability opportunities wherever possible;
- Identify cross-cutting issues and coordinate mitigation measures across topics to be incorporated in an Environmental and Social Management Plan (ESMP); and
- Incorporate 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 ESIA report is 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 describes 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 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

Chapter	Contents	AfDB Requirements
		links between stakeholder feedback and ESIA element. Confirm and verify stakeholder engagement activities. (2015)
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; – Ground Water; – Wetlands; – Air Quality; – Noise; – Transport / Access; – Waste Management; – Visual; – Biodiversity; and – Socio-economic.	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) 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. 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 to be focused upon in the ESIA process.	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		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 11 – Environmental and	Presents the action plan for the management of impacts	Identify measures to avoid, minimise and mitigate.

Chapter	Contents	AfDB Requirements
Social Management Plan	throughout the construction and operation of the proposed project.	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 the 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 Zereu Girmay Environmental Consultant (ZGEC) which is a local Ethiopian Consultancy firm licensed with the MEFCC (see **Appendix A**). International ESIA experience and supplementary specialist expertise was provided by WSP Environment and Energy, Africa.

Table 1-4: ESIA Project Local Team

Technical Area	Expert	Level of Licences with MEFCC	Reference number of Certificate
Policy Analyst	Mr Bereket Zeleke Ekule	Consultant	11/1-1/1414
Sociologist	Mr Gebreslassie Gebreamlak Mersha	Senior Consultant	11/1-1/4011
Environmental Health	Mr Aklilu Tilahun Zeleke	Senior Consultant	11/1-1/1015
Land Use	Getachew Semegn Eshetu	Senior Consultant	11/1-1/6876
Biodiversity	Mr. Shewaye Deribe W/Yohannis	Senior Consultant	11/1-1/6587
Water Resource Management	Solomon Kebede Gizaw	Senior Consultant	11/1-1/4026

Technical Area	Expert	Level of Licences with MEFCC	Reference number of Certificate
Environmental Engineer	Mr Agaje Mekonen Agaje	Senior Consultant	11/1-1/7079
Waste Management	Mr Zereu Ghirmay Ghebreslassie	Senior Consultant	11/1-1/1959/10

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 and 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	Tigray Region IPDC
Responsible Person	Guesh Menkr
Telephone	0930468862
E-mail	gmenkr@gmail.com

Table 1-6: Detail of the Environmental Assessment Practitioner

Item	Detail
Name of Firm	Zeriou Girmay Gebreselassie Environmental Consultant
Certificate of Competence	Environmental Impact Assessment Studies as a Consulting Firm in Level 1 Reference Number: 11/1.1/6883 Date: 29/9/2016
Responsible Person	Mr. Zereu Girmay
Postal Address	100187 Addis Ababa, Ethiopia
Telephone	091 134 7013 or +251 11 557 63 95
E-mail	zereu21@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; and
- 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 Baeker IAIP and Mai Kadra RTC facilities and associated phases.

2.1 BAEKER IAIP

2.1.1 LOCATION

The proposed Baeker IAIP falls under the jurisdiction of Baeker Town of the Kafta Humera Woreda within the Western administrative zone in the Tigray Region (**Figure 2-1**). The site abuts the highway which connects Gondar and Humera which are approximately 220 km southeast and 35 km northwest of the site respectively. As the proposed site is located close to Humera, the major town of the zone, it allows the proposed development to tap into the existing social infrastructure in terms of banking, financial, recreational and logistics support. The town of Baeker, located approximately 10 km southeast of the site, has also been identified to provide support to a limited extent. The site is geographically located between 1551441.444 N to 1553690.188 N, and 258456.447 E to 260555.195 E (UTM coordinates).

The proposed Baeker IAIP is 255.14 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 255.14 ha pilot development. Future expansion of the IAIP will require separate environmental and social assessments to be undertaken.

Currently the land is used solely for agricultural purposes, predominantly the production of sesame and sorghum crops. There are no dwellings on the site nor other social infrastructure.

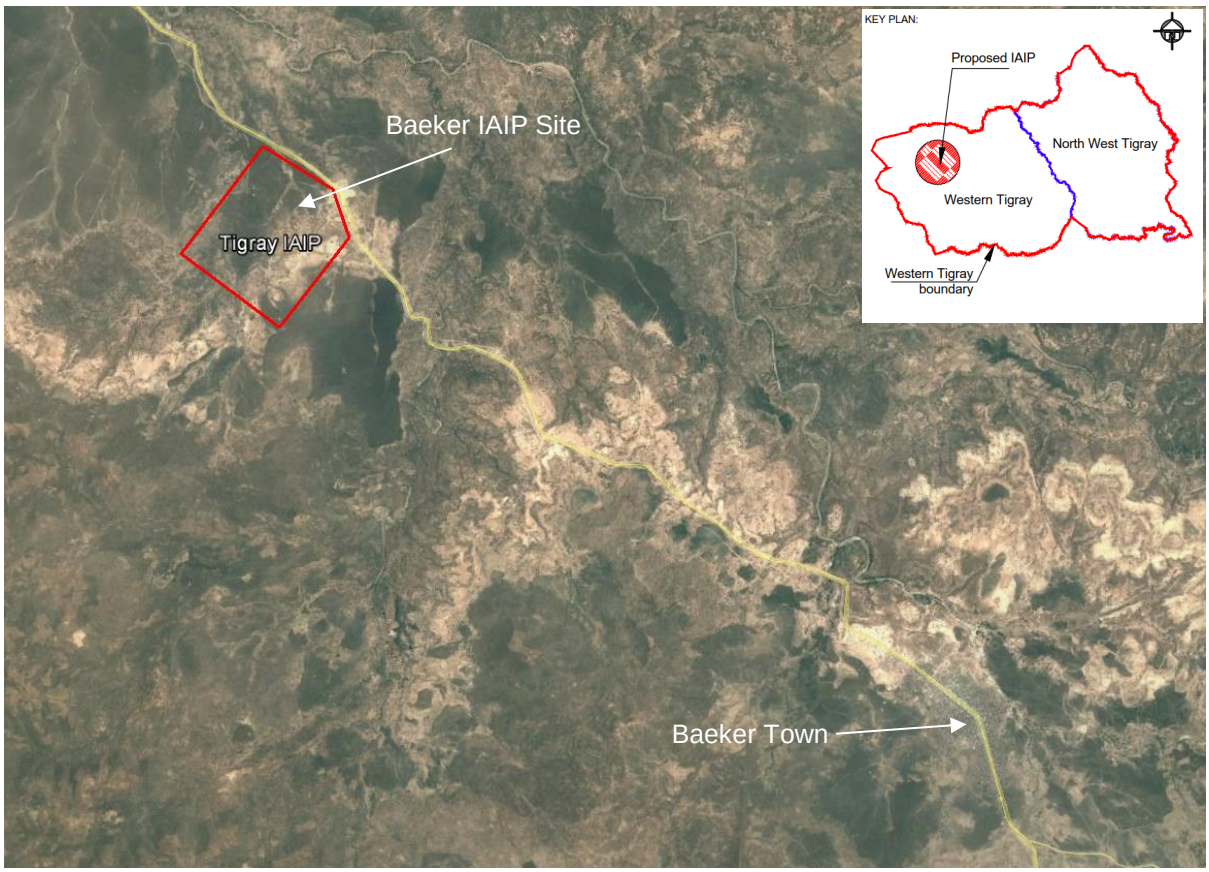

Figure 2-1: Location of Baeker IAIP, Tigray Region, in relation to Baeker Town (Google Earth Image)

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

Figure 2-2: Layout showing the boundary of the IAIP area (Google Earth Image)

Table 2-1: Coordinates of the Baeker IAIP site

Point	Easting (m)	Northing (m)
1	259481.376	1553690.188
2	260354.345	1553148.457
3	260555.195	1552546.057
4	259678.132	1551441.444
5	258456.447	1552359.225

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 agricultural land including land for crop production and open grassland for grazing, with limited very low density settlements and support infrastructure such as roads and electrical power lines. The area includes mixed vegetation as well as the Samina River, located approximately 1.5 km east of the proposed site. A large portion of the area includes barren / degraded land. **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**.

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

Land use classification	Spatial Coverage in	
	Hectares (ha)	Percentage (%)
Water body	57.70	0.74
Agriculture	3039.29	38.72
Mixed vegetation	2881.60	36.70
Settlements	2.65	0.03
Barren land	1860.20	23.70
Roads	8.56	0.11
Total	**7850.00**	**100.00**

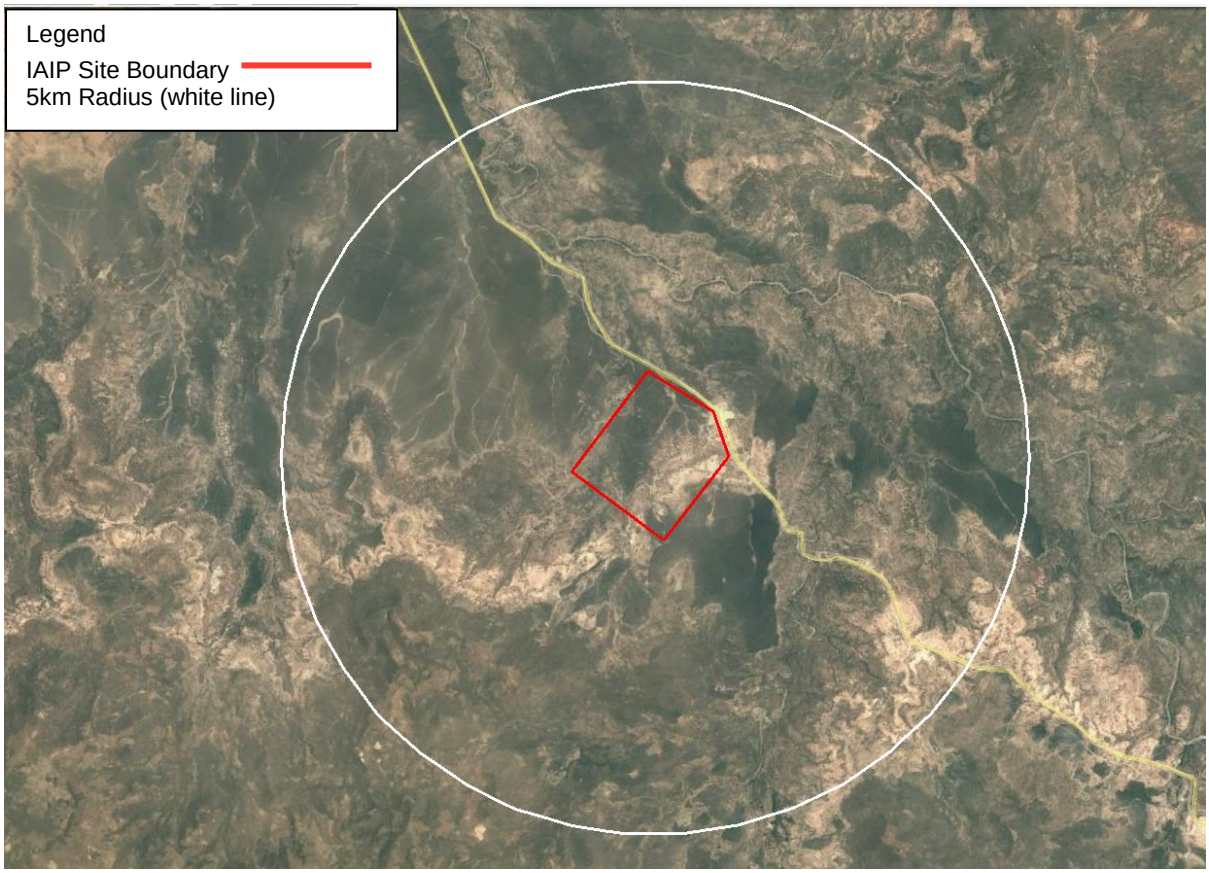

Figure 2-3: Image showing a 5km radius from the IAIP site (Google Earth Image)

2.1.3 DESCRIPTION OF THE PROPOSED BAEKER IAIP

The 255.14 ha IAIP is comprised of a processing area of 226.74 ha, a non-processing area of 23.04 ha, an existing stream bed of 2,72 ha and a green buffer area on either side of the stream bed of 2.64 ha. Most residents in the region are subsistence farmers with practices including the rearing of live animals as well as growing several crop types. The IAIP is designed to focus on processing cereals, sesame, livestock as well as fruits and vegetables and the brewery processing industry.

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. 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 with supporting facilities such as a school, places of worship and commercial areas. The park also includes communal greenery and open spaces making up approximately 16% of the total area. The total greenery and

open space area across the overall masterplan will be significantly higher than this as every development parcel may only make use of a maximum of 75% of the land under possession. This requirement is set within Article 5(5) of the Industrial Parks Council of Ministers Regulations No. 417/2017. **Figure 2-4** provides a layout of the proposed site layout plan of the Baeker IAIP.

Figure 2-4: Site layout plan of the Baeker IAIP (Source: MACE Master Plan_MACE-P942-WT-BA-MP-001, dated 04/09/2017)

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 undertaken to date.

Table 2-3: IAIP operational requirements

Item	Quantity
Raw Materials Required	897,522 MTPA
Growing Area Required	524,706 ha

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

Table 2-4: Summary of preliminary details of the Baeker IAIP

Tigray – Western Tigray – Baeker IAIP		
Location of IAIP		Baeker town in Western Tigray administrative zone
Size of IAIP		255.14 hectares considered for initial development
RTC locations		**Mai Kadra**, Setit-humera, Adigoshu, Adi-hirdi, Maygaba, Dansha and Shire-Indaselassie.
Agricultural potential and agri-facilities		Sorghum, sesame, fruits and vegetables, dairy, meat and other animal products
External infrastructure	*Energy*	Power source available – Humera substation – 34.8km
	Water	11 bore wells, with a 300 mm diameter and depth of up to 120 m
	Road network	The site abuts the Gondar to Humera highway
	Railways, dry port, airport terminals	Airport – Bole International airport, Addis Ababa – 951 km, domestic Humera airport – 25 km, Axum airport – 330 km and Alula Aba Nega Airport, Mekele – 630 km
	Telecommunication	Communication facilities available in Humera town can be extended, mobile telephone connection available.
IAIP internal infrastructure details	*Raw materials required*	897 522 MTPA
	Growing area required	524 706 hectares
	Total processing area	226.74 hectares
	Total non-processing area	23.04 hectares
	Existing stream area	2.72 hectares
	Green buffer on either side of the stream	2.64 hectares
	Total area	255.14 hectares
	Length of road	10.111 km
	Total water demand	4782 m^3/day
	Wastewater generation	1791.35 m^3/day
	Municipal Solid Waste generation	6.223 TPD
	Power demand	41.81 MVA

Source: UNIDO, integrated Agro-Industrial Parks in Ethiopia, 2016 and MACE input, December 2017.

2.1.4 PROCESS UTILITIES

WATER REQUIREMENTS

Water supply to Baeker town is currently provided through a network of bore wells sunk in and around the town. During discussions with the authorities, undertaken by MACE, it was identified that there is no surplus water available from this scheme to supply the IAIP. Furthermore the Samina River, flowing to the north and east of the site, was noted to be a non-perennial river and as such is dry for

parts of the year and is therefore not a viable option for water supply to the IAIP. The Tigray IAIP site is situated approximately 4 km away from the Bombeia River, which is also non-perennial and drains into the Pawiyan Shet River which then flows into the Tekeze River.

Groundwater use in the vicinity of the Baeker IAIP site is relatively limited, with no active groundwater abstraction/utilisation points being identified within the proposed Project boundaries. Two shallow hand dug wells were identified in the area, one of which had been dug in a stream channel. Water levels in these wells were relatively shallow, with water levels of 0 meters and 7.1 meters below surface being recorded in the two wells respectively.

Based on the information gathered, MACE propose that a minimum of 11 bore wells, with a 300 mm diameter and depth of up to 120 m, be installed in the proposed project area (or nearby vicinity depending on the yield of the bore wells). The estimated total daily water demand for the IAIP was calculated by MACE, including potable[1] and non-potable[2] water requirements and is reflected in **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	3825	563	4388
Non-processing area	253	141	394
Total daily water demand	**4078**	**704**	**4782**

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 IAIP, showing the anticipated annual increase in water demand.

Table 2-6: Water demand - year wise patter - cum/day

Year	2018	2019	2020	2021	2022	2023	2024	2025	2026
Volume (m^3/day)	478	956	1792	2310	3027	3505	3864	4078	4078

To facilitate the adequate supply of water to the IAIP suitable water storage structures in the form of ground level storage reservoirs (GLSR) and elevated level storage reservoirs (ELSR), with associated 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 respectively) for further distribution. An area of 3.25 ha is earmarked for the construction of the water treatment plant, GLSR and ELSR and Pump House within the IAIP. The design also includes a 'summer storage tank' for the capturing and storage of rain water for use in the IAIP during summer.

A suitable water treatment plant is to be established to treat the water in order to meet the acceptable limits of water quality as per Ethiopian drinking water standards. Based on historical water quality results for the region the water supplied by borehole, springs and surface water resources shows that all parameters are well within the acceptable limits, however TDS is above the permissible limits.

WASTEWATER

Based on the MACE '*Design and detailed engineering report for sewer collection system – IAIP at Baeker – Western Tigray*', dated 04/10/2017, a sewage treatment plant (STP) and common effluent treatment plant (CETP) are to be established within the northern portion of the IAIP. Wastewater generated by toilets is considered as domestic sewage and wastewater generated from bath/shower, laundry, hand wash basin and kitchen is considered sullage/greywater. It is anticipated that wastewater generated by production processes, equipment and regular maintenance at each of the

[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

facilities will be recycled for reuse in the operational process. The basis of this sewer system design assumes that each industry will treat their effluents and use the treated effluent within their premises based on a '*zero liquid discharge*' concept. While 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.

Baeker town does not have an existing sanitary landfill facility. The next closest town is Humera, approximately 35 km northwest of the site, which only possess a controlled dump site which is fenced. The dumpsite is approximately 5 ha in extent and is not fit for receiving STP sludge waste. Neither of the towns administration have immediate plans to develop a sanitary landfill facility. Therefore there is no suitable landfill space to receive sewage sludge generated by the IAIP and the facility will need to be operated as a zero waste facility.

The Sequencing Batch Reactor (SBR) will be applied to clean the sewage water. This is a fill and draw activated sludge system. The raw sewage is first passed through a screening and grit removal process before going into the SBR process. The SBR basins, working in sequence, are equipped with air blowers, diffusers, return pumps, decanters and valves. The function of the SBR is to remove the organics, nitrogen and phosphorus acting on an extended activated sludge principle. The basic cycle comprises fill-aeration, settlement and decanting. The final waste sludge is then dewatered through a sludge sump and pump house and centrifuge and polyelectrolyte dosing system. According to the MACE design the dewatered sludge was then to be transported in trucks for disposal to sanitary landfills or for use as manure on agricultural land (page 30, Design and detailed engineering – Sewage Treatment Plant – IAIP at Baker – Western Tigray, 05/09/2017). Given the distinct absence of sanitary landfills in the Tigray region it will be necessary to retain sludge on site for final processing and reuse. The IAIP must therefore be a zero-discharge facility and no sludge is to be transported from the site. Future enterprises entering the site will be encourages to avoid the production of waste, mitigate the production of waste and ultimately reuse waste where generation cannot be avoided.

Treated wastewater 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 2-8**. Estimated wastewater generation for the IAIP are presented in **Table 2-8**.

Table 2-7: Estimated Sewage generation for the IAIP (ref: Table #2, MACE-P942-WY-BA-SE-DOC-001, R3, 04/1-/2017)

Processing and Non-processing areas	Quantity
Processing Areas	2201.97 m^3/day
Non-processing	305.42 m^3/day
Total	**2,470.29 m^3/day**

Table 2-8: Estimated average daily wastewater generation for the IAIP (ref: Table #4, MACE-P942-WY-BA-SE-DOC-001, R3, 04/1-/2017)

Processing and Non-processing areas	Quantity
Processing Areas	1485.93 m^3/day
Non-processing	305.42 m^3/day
Total	**1,791.35 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 2-9**. Waste minimisation, recycling and treatment processes shall be included in the IAIP facility operational requirements. It is anticipated that solid waste will be either recovered, by

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

pre-qualified contractors at the site, or disposed of. Should the waste be disposed of offsite a suitable disposal site will have to be established.

Table 2-9: Estimated average daily solid waste generation for the IAIP

Processing and Non-processing areas	Quantity
Total	179.13 kg/day

ELECTRICITY

The total power demand for the IAIP during operation is anticipated to be 41.806 MVA, as indicated in **Table 2-10**. The total power demand is proposed to be sourced from Ethiopian Electric Power (EEP) via the substation at Humera Town, located approximately 35 km from the proposed site.

Table 2-10: Estimated power demand for the IAIP

Land use	Quantity
Processing area	32.334 MVA
Non-processing area	9.472 MVA
Total Power Requirement	**41.806 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 parking area with a fuel station. The storage of fuel will therefore take place on site.

TRANSPORT ROUTES AND ACCESS TO SITE

The proposed site abuts the federal highway connecting Humera and Gondar. 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 (international) and Humera (domestic) which are approximately 950 km and 25 km from the site respectively. 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 POWER TRANSMISSION LINES

As identified in Section 2.1.4 it is proposed to bring in an overhead power transmission line from the Humera substation, which is connected to the national grid, to a substation to be established on site for the provision of electrical supply to the IAIP. The EEP is responsible for establishing the overhead power line to the site, however; this will be subject to a separate ESIA process.

COMMUNICATION FACILITIES

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

2.2 MAI KADRA RTC

2.2.1 LOCATION

The proposed Mai Kadra RTC site (**Figure 2-5**) is located approximately 1.5 km south of town of Mai Kadra, 25 km south of Humera, and approximately 23 km west of the Baeker IAIP (50 km by road via Humera). The proposed site falls under the jurisdiction of Mai Kadra town, located in the Western Zone of the Tigray Region. The proposed RTC abuts the highway that connects Humera and Sudan. The site is geographically located between 1554941.124 N to 1555276.552 N and 237326.294 E to 237636.305 E (UTM coordinates).

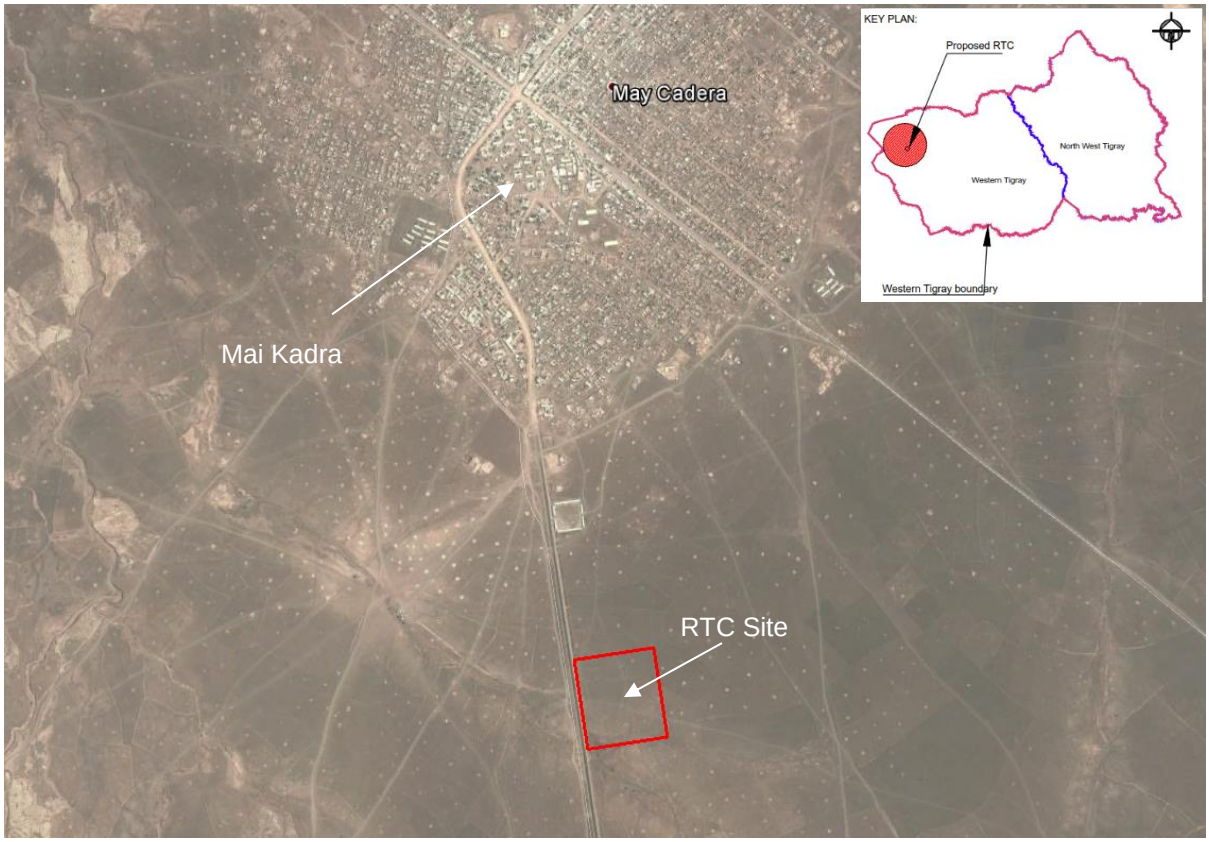

Figure 2-5: Location of Mai Kadra RTC, Tigray Region, in relation to Mai Kadra Town (Google Earth Image)

The Coordinates of the Mai Kadra RTC area are provided in **Table 2-11**. **Figure 2-6** shows the layout of the IAIP boundary.

Table 2-11: Coordinates of the Mai Kadra RTC site

Point	Easting (m)	Northing (m)
1	237326.294	1555238.060
2	237593.536	1555276.552
3	237636.305	1554979.616
4	237369.063	1554941.124

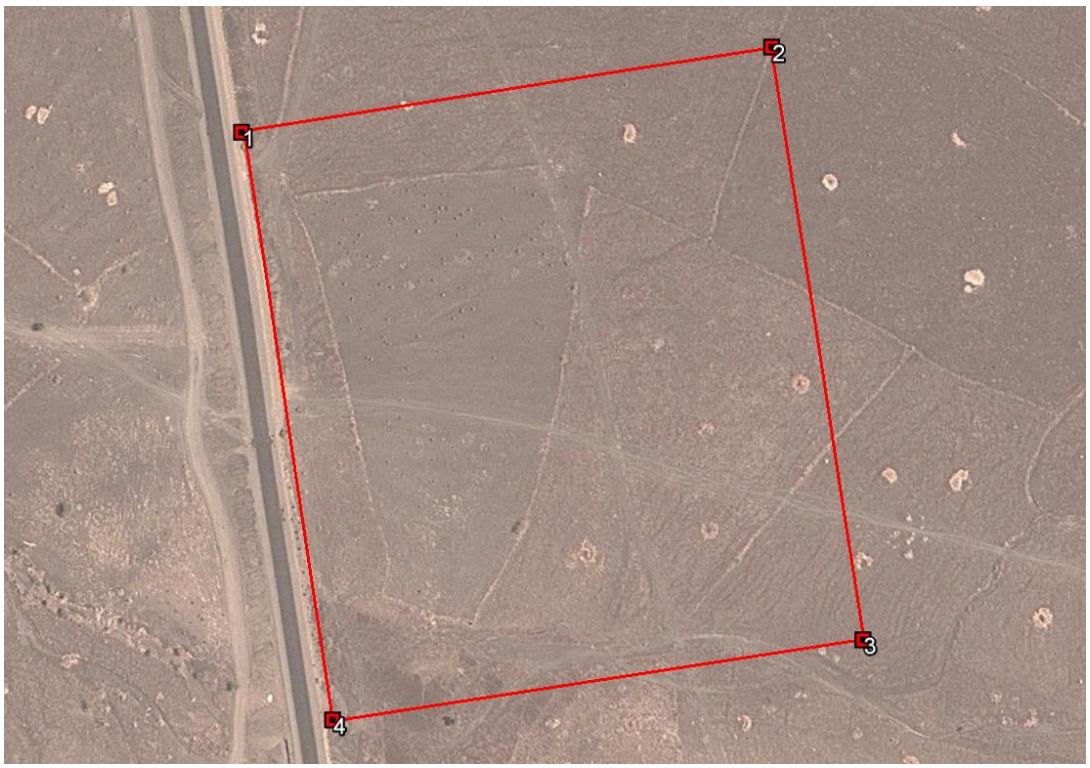

Figure 2-6: Layout showing the boundary of the Mai Kadra RTC site, Western Tigray Region

2.2.2 SURROUNDING AREA

The site is located on the eastern side of the highway and is surrounded by agricultural land (predominantly crops). The development edge of Mai Kadra commences approximately 500 m north of the site (**Figure 2-7**). A 33 kV overhead power line runs parallel to the site on the western side of the highway.

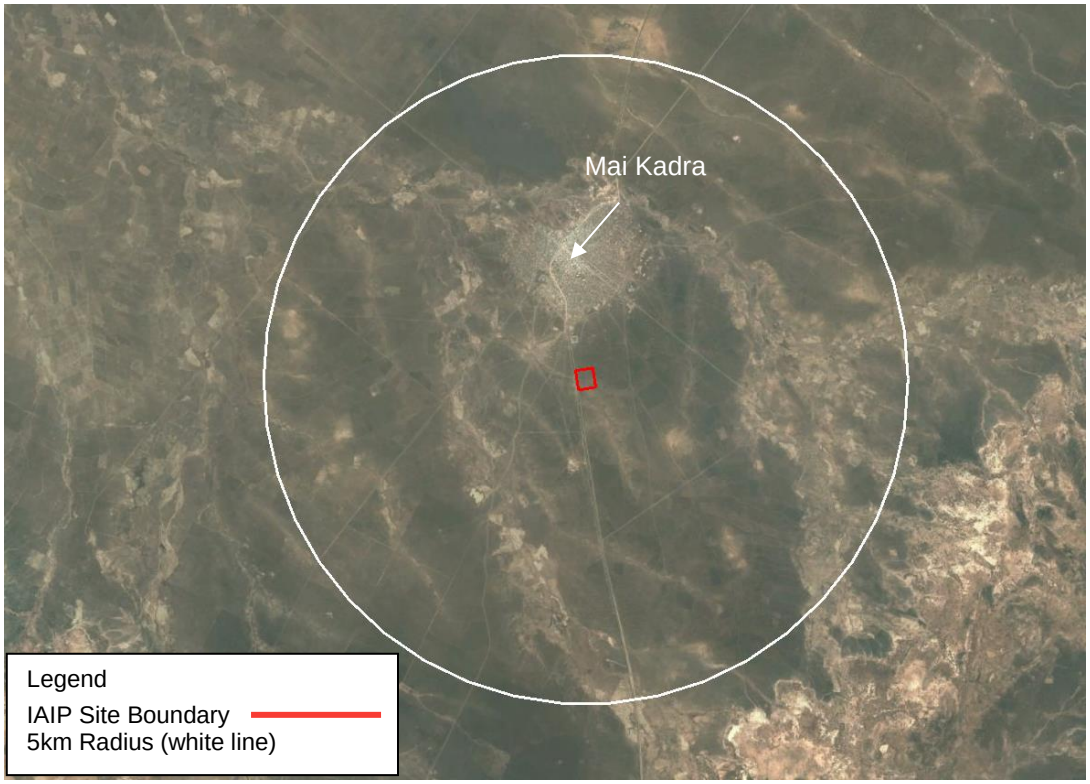

Figure 2-7: Image showing a 5km radius from the RTC site

2.2.3 DESCRIPTION

An RTC is envisaged to provide backward linkage to the IAIP, the commodities handled within the RTC would be agriculture and allied sector products. Analysis of the agriculture products within the catchment area of the RTC, undertaken by MACE, revealed that the following products could be the potential commodities handled within RTC.

- Cereals and pulses;
- Livestock;
- Dairy products including milk; and
- Vegetables.

The Mai Kadra RTC site covers an extent of 8.10 ha which consists of agricultural land (crops). No dwellings are present on the site, nor any other social infrastructure. **Figure 2-8** identifies the existing features identified in the area of the proposed RTC site.

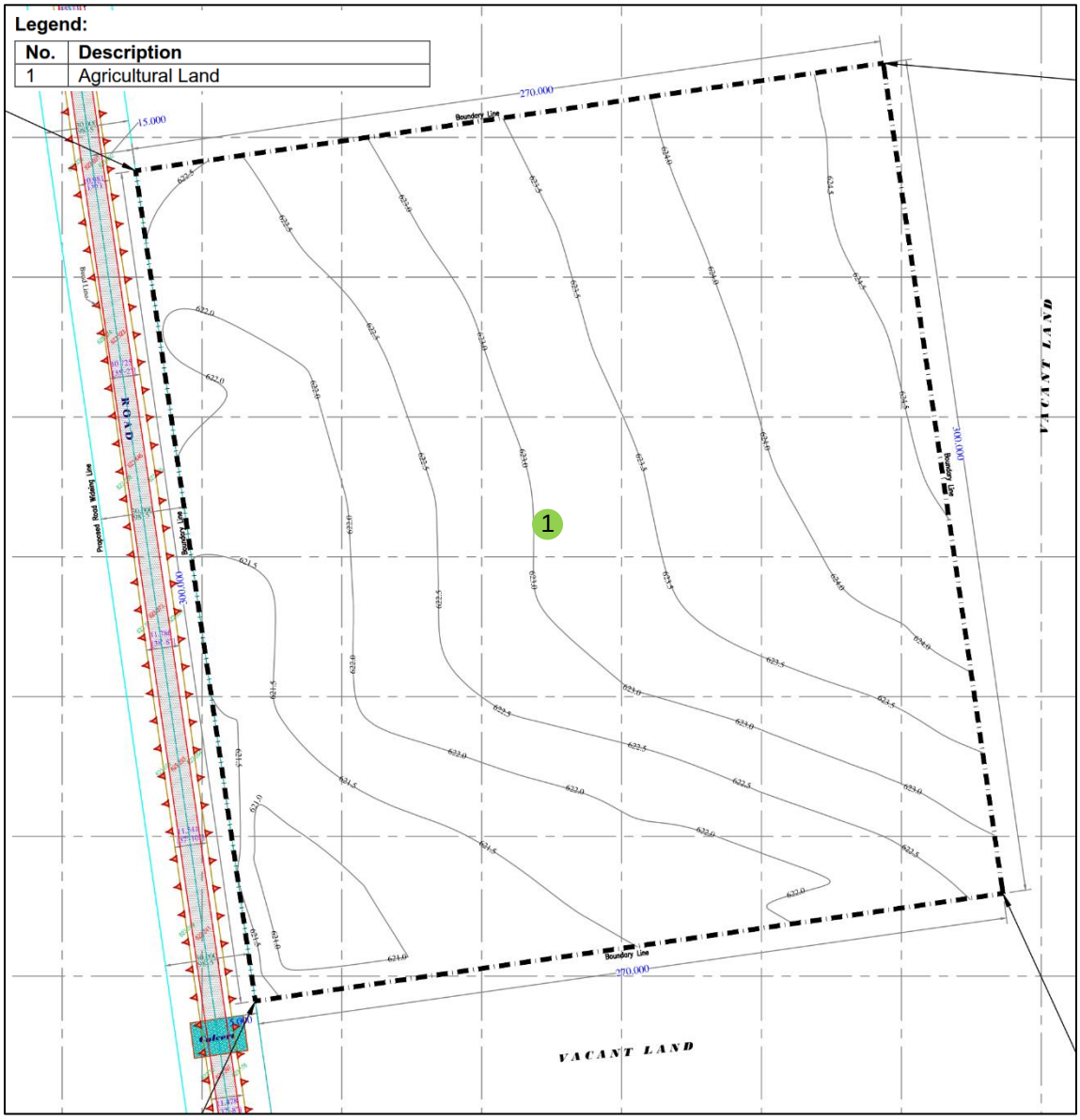

Figure 2-8: Existing features within the proposed RTC site (Source: adapted from MACE layout)

The RTC is to be focused on fruits, vegetables, cereals, livestock, milk, eggs and honey. Furthermore the RTC contains a quality control laboratory and other social infrastructure such as a rural market, training centre and crèche. The social infrastructure provides the necessary support for the occupant

industries in the RTC. **Figure 2-9** provides a layout of the proposed master plan for the Mai Kadra RTC.

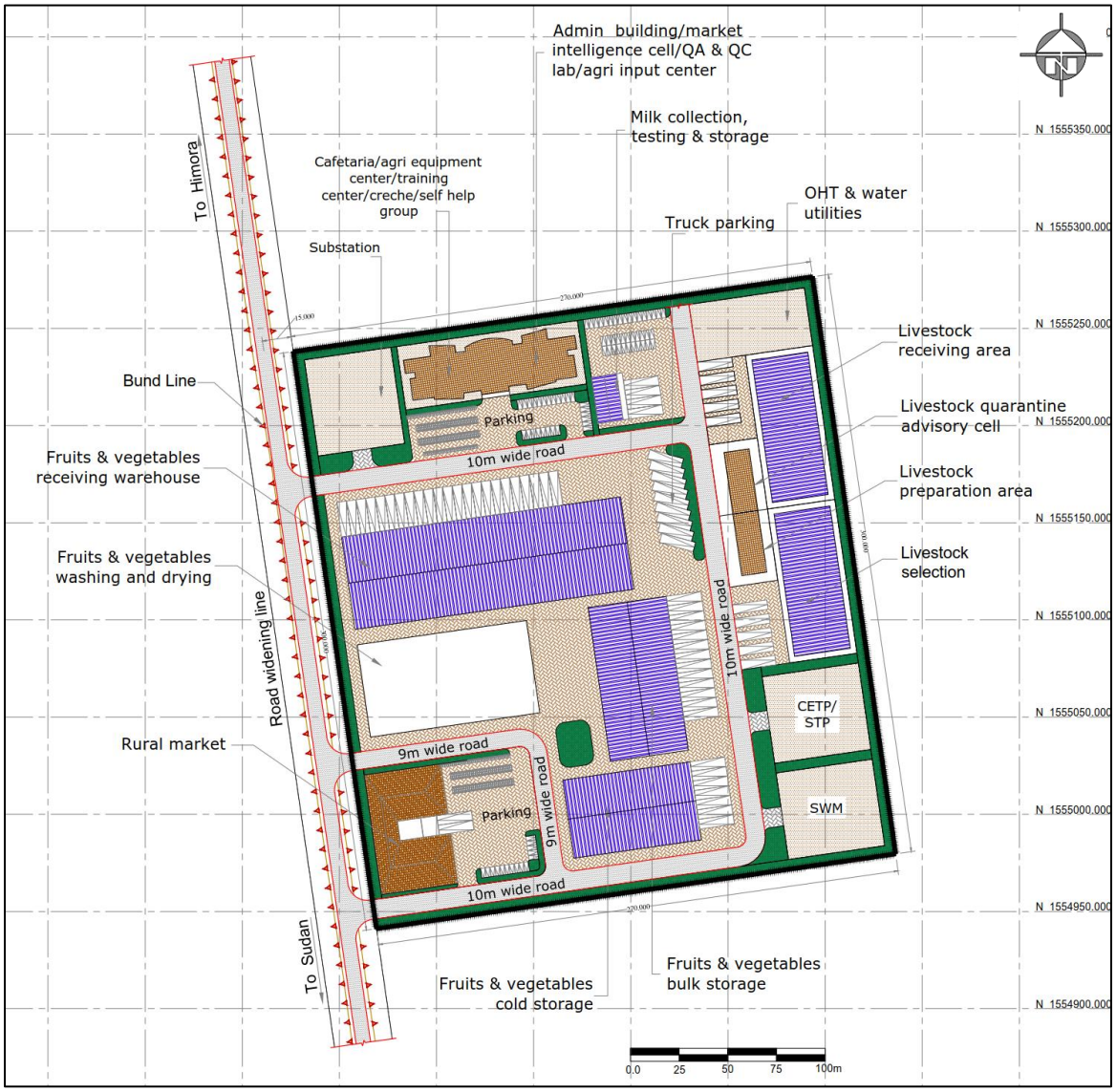

Figure 2-9: Master Plan of the Mai Kadra RTC (adapted from MACE Master Plan Drawing)

2.2.4 PROCESS UTILITIES

WATER REQUIREMENTS

The total estimated water demand for the RTC was calculated by MACE to be 78.54 m^3/day, including potable[4] and non-potable[5] water requirements (**Table 2-12**). Presently water is supplied to the town of Mai Kadra by a water supply scheme located approximately 1 km from the proposed site, however; based on discussions held by MACE with the regional authorities it was been identified that there is no surplus water available in the existing scheme to supply the RTC.

It is therefore proposed to sink two deep bore wells within the RTC site to meet the required demand.

Table 2-12: Estimated average daily water demand for the RTC

[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

Description	Potable (m^3/day)	Non-potable (m^3/day)	Total (m^3/day)
Total water demand	60.67	17.87	**78.54**

To facilitate the continuous provision of water supply to the RTC, suitable water storage structures in the form of an underground sump, elevated level storage reservoirs (ELSR) with a 12 m staging height, and pump house are to be established within the RTC to facilitate receiving raw water, treating the water, collecting the treated water and storing the water in a ELSR for further distribution. An area of 0.18 ha is earmarked for the construction of the water utilities within the RTC.

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

WASTEWATER

A STP is to be established within the RTC. It is anticipated that waste water produced by equipment and regular maintenance will be recycled in the operational process. Furthermore sanitary wastewater from toilets and urinals shall be collected in an underground sewer system that will be constructed as part of the processing plants sanitary facilities. A self-contained treatment system will be put in place to treat sanitary water.

Mai Kadra town does not have an existing sanitary landfill facility. The next closest town is Humera which, as indicated above, only possess a controlled dump site which is not fit for receiving STP sludge waste. There are no immediate plans in either Mai Kadra or Humera towns to develop a sanitary landfill facility. Sludge handling and the disposal thereof must be addressed within the RTC in order to ensure a zero waste discharge facility.

Treated wastewater is to be re-used in the facilities processes as non-potable water.

SOLID WASTE

A solid waste management area has been identified within the RTC master plan. A waste management plan is included in the ESIA for the RTC identifying measures to avoid, reduce or reuse waste.

ELECTRICITY

It is proposed that the EEP provide power to the site from the existing 33 kV power line passing on the western side of the highway. This process is to be undertaken by the EEP.

2.2.5 ANCILLARY INFRASTRUCTURE

This Section provide a brief summary of what 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 gained from three points, accessible directly from the existing highway (refer to **Figure 2-9**). 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 POWER LINES

It is understood that the power for the RTC facility is to be sourced from the overhead power line currently passing on the western side of the highway. The EEP will be responsible for providing power to the site.

COMMUNICATION FACILITIES

Communication facilities available in the town of Mai Kadra 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 authorisations have been issued by the relevant authorities.

2.3.2 CONSTRUCTION PHASE

The construction process of all horizontal infrastructure and common facility buildings is anticipated to continue for a period of approximately 12 months from commencement, following receipt of environmental certification. Development of individual sites within the IAIP will continue for an extended period as per demand.

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 (note: the additional RTCs are not included in this assessment).

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, etc.) 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 Baeker IAIP and Mai Kadra RTC site and associated activities.

2.3.4 DECOMMISSIONING PHASE

The proposed IAIP and associated RTCs are intended to be long term operational facilities (i.e. are not intended to be decommissioned in the near future). The developments are anticipated to be a permanent part of the industrialised agricultural sector going forward and are to be expanded upon.

Decommissioning requirements and activities should be considered in the planning process, however as the facilities are not anticipated to be decommissioned in the near future is more appropriate that detailed decommissioning requirements should be addressed in the future when / if decommission of the facilities is required. As such decommissioning is not considered further in this report.

2.4 PROJECT STATUS

It is noted that construction of certain aspects of the proposed Project development have commenced. The following points summarise the status of the construction undertaken to date for the Tigray IAIP and RTC sites and the respective infrastructure, based on the latest information provided by the IPDC:

- Tigray Road and Construction Enterprise has a year contract to construct the compound wall for the IAIP site and the RTC site. Construction of the boundary walls commenced early in 2017 and the construction activities are approximately 70% complete.
- SUR Construction PLC have been appointed to construct the horizontal infrastructure and common building facilities at the IAIP Baeker and Mai Kadra sites. These facilities include:
  - At Baeker IAIP, the road network, residential apartments and houses, administrative building, information kiosk and marketing facilities, poly clinic, retail space, training centre, sewerage system, internal power distribution lines and water supply network. The company has surveyed the site and cleared it, delivered construction materials to the site, mobilised machinery and equipment and commenced construction work.
  - At the Mai Kadra RTC, the aggregation centre, general amenity, livestock preparation shed, milk collection testing and storage, receiving warehouse shed, rural market building, livestock receiving shed, stormwater infrastructure, road network, internal power distribution lines, sewerage distribution, and water supply lines.
- Tigray Water Works Construction Enterprise has been appointed to undertake the deep well drilling on both the IAIP and RTC sites. Drilling has commenced and is estimated to be 50% complete at the Baeker IAIP site and approximately 18% complete at the Mai Kadra RTC site.

It is noted that as per the legislative framework, construction activities are required to only commence following receipt of environmental certification. These activities are therefore in non-compliance with the identified regulations.

3 NEED AND DESIRABILTY

The agricultural industry in Ethiopia faces the following challenges:

- Disorganised and fragmented land holdings;
- Absence of an integrated channel to link 'farm gate to food plate';
- Weak infrastructure, limited support services to farmers;
- > 50% of Food Industries concentrated in & around Addis Ababa;
- Inability to tap the growing domestic & international markets;
- 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 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 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 industrialization 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 curb shortages'* in the course of production. The intention is for the IAIPs to be a 'one-stop-shop' for agricultural industries and to facilitate and boost the export earnings for Ethiopia, which is currently restricted to coffee and sesame exports. Investors, both local and foreign will also be attracted to incentives ranging from 70% loans 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:

- 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 as 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 Tigray Region, such as cereals and sesame. 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 four pilot IAIPs and 28 RTCs developed. The selected sites are in Central Eastern Oromia, Southwest Amhara, Eastern SNNP 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 IAIP is unknown while it has been indicated that over 15 initial sites were identified for the location of RTCs. This was limited to 8 sites following an initial assessment. This process was undertaken at a high level and little documentation exists on the process and methods used to determine the most preferred sites.

4.3.3 SITE LAYOUT ALTERNATIVES

Site layout alternatives have been considered for the Baeker IAIP site. Following site selection, a site survey was undertaken to determine the sites opportunities and constraints. During this site work, a non-perennial stream was identified crossing the western corner of the site. The initial approach to dealing with this feature was to reroute the stream along the western boundary of the site. The initial site plan layout prepared for the Baeker IAIP (**Figure 4-1**) identified the presence of the stream but showed the IAIP development over the stream and the stream being diverted in perimeter drainage channels for periods when the stream was flowing.

Figure 4-1: Initial site plan layout for the Baeker IAIP

Following the environmental site reconnaissance work undertaken in March 2016, by the ESIA team, it was recommended that this drainage feature remain in-situ and the Masterplan design seek to avoid this natural feature in order to limit the impact on the surrounding natural features. The revised masterplan, which has been assessed within this ESIA, avoids the perennial stream in the western corner of the site and instead provides for the stream to pass through the IAIP site with a suitable green buffer area adjacent to the stream to maintain its natural features. The revised master plan represents an improvement on the initial masterplan and provides a more environmentally sensitive design.

4.3.4 TECHNOLOGY ALTERNATIVES

Sewage treatment options were considered for the IAIP site. The various sewerage treatment systems considered for selection are given 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.

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

In the event of abandonment of the IAIP, 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 Tigray IAIP and RTC project, economic development of the Western Tigray 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 Tigray Region with the IAIP and the RTC located in the Western 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

Ministry of Environment, Forest and Climate Change 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 Federal 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 the 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 for 12 identified industrial sectors.
- 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.
- EIA Procedural Guideline (draft), November 2003*:* This guideline outlines the screening, review and approval process for development projects in Ethiopia and defines the criteria for undertaking an EIA.
- Draft Guideline for Environmental Management Plan for the Identified Sectorial Developments in the Ethiopian Sustainable Development and 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 or 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;
- The United Nations Convention on Biological Diversity (Rio Convention), 1992; and
- RAMSAR Convention on Wetlands of International Importance.

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 standards 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 African Development Bank Policy package 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:

- **Operation 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.

SOCIO-ECONOMIC IMPACTS OVERVIEW

No residential properties or houses were recorded by the local authorities during their census and it has been confirmed (during the WSP team visits) that only farmland (and no residential properties) will be affected by the Tigray IAIP facilities' development. This was again confirmed during consultation meetings, when it was identified that the affected property at both the IAIP and RTC sites includes farm land and no other assets such as houses, communal facilities or infrastructure will be impacted.

Based on the Ethiopian Constitution, the land is the property of the State and all farmers are in essence, tenants who cultivate land and enjoy benefits of their labour, but as they do not own such land they cannot sell or buy it. On this basis, the economically affected PAPs cannot be compensated for their affected land plots and the IPDC and PIU will be working with the local authorities to ensure all affected PAPs end up with "new" land plots which can either be provided for them by local authorities or obtained/chosen by PAPs themselves through new tenant agreements.

Changes requiring people to obtain new land plots, inevitably lead to certain expenses, for example, administrative costs for finalising and legalising a tenant agreements for the "new" land plot and/or cost of fertiliser required for the new land plot. These costs associated with the economic displacement, will be additionally compensated by the IPDC (see details below in Table 5, Entitlement Matrix).

Local authority data did not identify what types of crops would be affected due to the development of the IAIP and RTC facilities; however, local surveys undertaken by WSP indicate that the main annual crops in the area is sesame. The average current area of land owned by the PAPs is 7.41 and 4.47 hectares for Baeker and Mai Kadra, respectively. These figures are smaller in comparison to the average area of land owned by respondents in the WSP survey, which displayed an average land ownership of 9.92 hectares.

The total area of farmland to be affected in Baeker area is 163.1 hectares, with an average land area of 5.26 hectares per farmer. Of the 31 PAPs to be affected in Baeker, 20 have all of their land set to be taken by the IAIP facility. The land area to be affected is broken up between both small and large expanses of agricultural land, with the details provided below:

- 95.6 ha large holders and investors (5 PAPs); and
- 67.5 ha small holders (26 PAPs).

The total area of farmland to be affected in the Mai Kadra area is 8.1 hectares, with a much smaller average land area of 0.91 hectares per farmer. All of the agricultural land in the Mai Kadra area is owned by small holders.

In instances where PAPs have only a fractional proportion of land being affected and relocated, it may be reasonable to assume that separately owned cultivated land areas (especially new land areas located in distant areas) could be more impractical and difficult to manage. Therefore, the simplistic approach of a 'like for like' land area replacement should also take into consideration the actual impact severity on farmer's economic displacement.

These impacts are described below followed by the suggested mitigation measures to ensure compliance not only with the Ethiopian Land Expropriation and Resettlement legislation but also with the AfDB principles covered in their Operational Safeguard 2, Involuntary Displacement.

The proposed Tigray Project, including the Baeker IAIP and Mai Kadra RTC, will result in 40 PAPs being directly affected by the proposed development due to the loss of land, and therefore is considered a **Category 2 Project**. As described above, a Category 2 project is likely to cause less adverse environmental and social impacts and a simplified ESIA is applicable. However, based on discussions with the national authorities and to align the ESIA and Resettlement/Land Acquisition process between the four sites covered by this project, it was decided that the Baeker IAIP site development will be subject to the detailed ESIA and RAP and as such, treated as Category 1 project.

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 METHODOLOGY

The Environmental and Social Impact Assessment (ESIA) and Resettlement Action Plan (RAP) has been 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 Tigray IAIP and Mai Kadra RTC site is considered a **Category 2** project based on the number of people affected by the Project. A Category 2 project must have a limited ESIA process undertaken. The key steps to an AfDB ESIA are presented below.

6.1 SCOPING PHASE

The purpose of the scoping phase was 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 the scoping phase were 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 carried out a census, including asset inventory, to inform the relocation and compensation process.

During the site investigation stage, stakeholder engagement meetings were undertaken by the ESIA team 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 scoping stakeholder engagement process are presented in Chapter 7 of the ESIA Report. Minutes of the stakeholders and community consultation meetings have been 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 was 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 also described the baseline conditions of the environment that is then used during the impact assessment phase for both social and environmental impacts.

Site investigations were undertaken by the ESIA team from 28 August 2017 to 29 September 2017. The findings of the site investigations, and description of the baseline environment of the sites, are presented in Chapters 8 of the ESIA 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 have been 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 6 December 2017.

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.

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 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	Moderate, medium term rehabilitation of ecosystems or national significance, leading to observable and measurable changes. Moderate deterioration/improvements and changes / increase in the abundance and biodiversity of the area with moderate recovery periods to baseline conditions.

Category	Environmental Receptors – Physical And Biological	
	may result in the intervention by governmental bodies and stakeholders.	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. 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.	Retention of cultural heritage resources (of value) where possible and 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.

Category	Socio Economic Receptors	
	National and potentially international media and community concerns and ongoing long term complaints.	
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 will consider 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.

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 will need to 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 will be 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.

7 STAKEHOLDER ENGAGEMENT

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

7.1 APPROACH TO STAKEHOLDER ENGAGEMENT

Stakeholder engagement for the ESIA was 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

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 reportedly undertaken by the IPDC prior to the WSP involvement on the project (2014-2016), with the introduction of the project and census of the PAPs (early 2017). The local Authorities provided the WSP team with the record of when these meetings were held, their location and how many people attended. In addition, the more recent consultations (2017) were also captured. This information is provided in **Table 7-1** below.

Table 7-1 : Records of Consultations carried out by local authorities

Date	Stakeholder Category	Location
16/11/2016	- Discussions about the upcoming project, discuss forms of compensation. - Meeting facilitated by District administration and District Land administration. - Number of participants was 16 (12 women, 4 men)	IAIP/ Baeker
03/12/2016	- Meeting continued from the above, with a similar agenda - Number of participants was 12 (all men)	IAIP/ Baeker
24/12/2016	- Discussions about the upcoming project and forms of compensation. - Meeting facilitated by District administration and District Land administration. - Number of participants was 7 (5 men and 2 women).	RTC/ Mai Kadra
31/12/2016	- Meeting continued to the above, with a similar agenda. - Meeting facilitated by District administration and District Land administration. - Number of participants was 7 (5 men and 2 women)	RTC/ Mai Kadra
27/03/2017	- Agenda same as the above but this time there was discussion about location of the substitute land. - Facilitated by district administration.	Both IAIP & RTC Baeker and Mai Kadra Meeting held in Humera

Date	Stakeholder Category	Location
	- Number of participants was 21.	
07/04/2017	- The discussion covered the assets that will be compensated in cash and in-kind, for more details, see the Consultation section in the RAP. - Number of participants was 23 (13 women, 10 men).	Both IAIP & RTC, Baeker and Mai Kadra Meeting held in Humera

7.1.2 PRE COMPENSATION ACTIVITIES AND EARLIER STAKEHOLDER MEETINGS (2016)

The local authorities confirmed that they undertook a number of consultation meetings during the resettlement process that was started last year, and they provided the ESIA team with a list of the meetings undertaken to date (**Table 7-3** and **Table 7-4**).

Key issues and concerns raised during the consultation were taken into account during the ESIA preparation and will be addressed in the environmental and social management plan (ESMP). The pre-compensation activities and processes followed by IPDC / Tigray and the regional state are provided below in **Table 7-2**.

Table 7-2 : Pre Compensation and Consultation Activities

No	Activity	Date	Remark / out put
1	Assignment given to four officials to facilitate establishment of the IPDC Tigray (l*egal procedures, organizational structure, organizing office…etc.*)	June 17, 2016	
2	IPDC Tigray got official mandate to manage and lead the industrial park development in the region.	Dec, 2016	- Corporation obtained legal entity
3	IPDC Tigray made reconnaissance surveys and 1st community consultation meeting (*after establishment of the Park)* - Meeting conducted in Humera by calling likely PAPs from both sites / Baeker and Mai Kadra. - 31 from Baeker and 9 from Mai Kadra (total 40) were invited to attend the meeting. - Task force was established on the given date, to deal with property / land to be affected as a result of IAIP/ Baeker, and the how to replace or compensate PAPs; from concerned offices including: ▪ Zonal land administration ▪ Zonal Trade and Industry ▪ Zonal Urban development ▪ Baeker District Administration ▪ Baeker District mines and energy	Dec. 26, 2016	- Noted by the informants/IPDC Tigray that the region had been working on public consultation and preparation of sites for the Industry and similar issues, even before the official engagement of IPDC. - Main issues raised by the participants were: - Preference of In-cash compensation rather than in-kind / substitute land; however according to the IPDC Tigray, PAPs had been told by the meeting organisers that as per the regional regulation; they would be compensated by equivalent land instead of cash - Concern regarding pressure on the local infrastructures due to the anticipated influx of manpower from other places. (PAPs from Baeker)

No	Activity	Date	Remark / out put
	▪ Local administrative unit / Kebele The main agenda of the meeting was: - Introducing PAPs about the envisaged project (required land, objective, benefit to the people, anticipated infrastructure development…etc.) - Discussion about the proposed method of compensation. Compensation method proposed by the IPDC was in-kind compensation not-in cash) - Obtain feedback and opinion of PAPs		- Since the area is arid, the need to preserve the existing vegetation and give due attention for further plantation too. (PAPs from Baeker) - Priority to be given to the local people regarding the job opportunities created as a result of the project.
4	Similar to the above, task force established for RTC site / *Mai Kadra*, to: - Estimate property / land to be affected and - How to compensate PAPs	Jan. 2, 2017	
5	Compensation committee or Task force conducted surveying and valuing farms to be affected. It's noted that task force reported availability of land for substitute since June, 2017. *For both sites*	January – February 2017	- The affected property mainly consists of farm land; No other assets like houses, communal facilities or infrastructure. NB: This is the survey the results of which are still being awaited by ESIA team. - Total area of farm to be affected in Baeker 131 ha ▪ 63.8ha investors (5) ▪ 67.2ha small holders (26) - Total area of land to be affected in Mai Kadra 8.1 ha all owned by small holders (7).
6	Confirmation of census data and approval of compensation rates		*NB: The resettlement process has been started prior to the WSP team involvement. The census and assets inventory (both carried out by the authorities) provided the names of PAPs and compensation estimates assigned for each PAP. The WSP team provided a number of recommendations in the RAP, including that further consultations by the IPDC is necessary both with the PAPs and a suitable agriculture-related NGO to reach an agreement with PAPs on the compensation rates for land and general principles of the land acquisition process (as per the RAP recommendations).*

No	Activity	Date	Remark / out put
7	In kind compensation **Baeker** - All the 5 investors have got substitute land (63.8 ha) **Mai Kadra** - 2 Small holder PAPs have got substitute land - 7 PAPs	July 2017 June 2017	- The reasons for this task not to be finished are the following: (for both Baeker and Mai Kadra) - Preference by PAPs to be compensated in cash, instead of in-kind; on the other hand the regional regulation doesn't permit this. Thus it requires time to convince the people. - Since some of the PAPS have moved on and live in different locations (some far away from the site) it is difficult to consult and engage with them.

7.1.3 SCOPING ENGAGEMENT

Engagement during the Scoping phase involved a number of community meetings undertaken by the local consultant during August and September 2017. The objective of the engagements was 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 on the findings from the draft Scoping Report; 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 will 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 the 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 involved consultation with stakeholders at the federal, regional, and local levels.

During late 2016 and early 2017, further meetings with key stakeholders were carried out **by the ESIA field team** and provided an opportunity for further information disclosure on the details and the programme of the proposed survey. A summary of further stakeholder consultation is provided below in the following sections.

7.1.4 SCOPING BASELINE DATA GATHERING ENGAGEMENT

Baseline data gathering has been conducted at the IAIP and RTC sites. The primary purpose of this phase was to gather primary data for the socio-economic baseline, however; it is noted that the collection of information also involved engagement with stakeholders. This afforded stakeholders further opportunity to provide feedback or ask any questions regarding the proposed Project. Stakeholder engagement during this phase included key government stakeholders at the Woreda and Kebele level, community based organisations and local community members.

Scoping phase engagements were undertaken in August and September 2017. The primary objective of the engagements was to identify social receptors in the project area and identify stakeholders and social sensitivities in the areas selected for the IAIP and RTC development, as well as to disseminate the project information and to identify the key issues important for local residents and communities.

Meetings and interviews with community representatives and key stakeholder groups were engaged during the stakeholder meetings. **Table 7-3** provides a summary of consultation meetings held in the Baeker and Mai Kadra areas. Minutes of the meetings and supporting photographs are provided within **Appendix B**.

Table 7-3: Summary of Scoping Phase consultation meetings held within the Project area.

Meeting	Date	Venue	Stakeholders
1	28 and 29 August 2017	Kafta Humera, Baeker	Representatives of the community including Women's Association, Rural Federation, Farmers, Traders, Elders, Youth Association, Woreda Federation.
2	1 September 2017	Mai Kadra	Representatives from different sections of the community including elderly, women, youth and PAPs.
3	3 September 2017	Humera, Zonal Administration Office	Representative of Kafta Humera Woreda including: – Natural Resource Conservation Office – Agriculture and Rural Development Office – Education Office – Culture and Tourism Office – Water Resource Development Office – Health Office Representative of Kafta Sheraro National Park Acting Administrator of Kafta Humera Zone
4	21 September 2017	Baeker town hall	More than 38 participants representing different sections of the community including elderly, women, youth and PAPs and Ato Tsegay Gesesew, West Tigray Zone, Urban Development and Construction Department.

The consultees identified the following important issues regarding the proposed IAIP and RTC development:

- Expectation that the IAIP development project will benefit the area by creating jobs for the youth and other members of the community, thereby assisting to curbing migration, providing better market to the agricultural products of the farmer, in getting better value for their cattle and goats, and in attracting further development venture to their area. Priority for jobs to be given to youth during construction and operation of the IAIP.
- Expectation that the service sector in Humera town will grow due to anticipated influx of workers and visitors associated with the project, additionally that more opportunities in the hotel and tourism services will be created.
- Compensation issues relating to the considerable delay in providing replacement farm land to small farmers (i.e. who own less than 5 ha) whose farm land has been expropriated for the IAIP. Due to the delay one cropping season (i.e. the current year harvest season) has been missed.
- Compensation issues relating to confusion and misunderstanding between cash compensation and replacement land compensation. Some PAPs whose farmlands have been expropriated are seeking cash compensation, but the local administration is offering replacement farm land compensation in line with the regulations.
- Infrastructure issues relating to concern about the existing shortages of municipal water supply and electricity in Baeker town and additional requirements resulting from anticipated influx of workforce and labour to the IAIP during construction and operation.

- Potential threats to the forest resources in the area as a result of labour influx and dependence on firewood for domestic purposes.
- Health and safety issues relating to potential increase in spread of sexually transmitted diseases such as HIV, and security problems due to influx of people to the area.
- Waste Management issues relating to potential contamination of surface and groundwater resources.
- Education concerns in that the increased job opportunities may enhance school drop rates, additionally that the influx of additional labour to the area will place additional pressure on the available schools in the area.
- Concern that with the introduction of new seeds and plants into the area different kind of plant diseases alien invasive species might occur in the area.
- Concern regarding land degradation during construction and operation periods.

7.1.5 ESIA DISCLOSURE ENGAGEMENT

In November 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 7-4** provides a summary of consultation meetings held in the Baeker and Mai Kadra areas. Minutes of the meetings and supporting photographs are provided within **Appendix B**.

Table 7-4 : Summary of ESIA Phase consultation meetings held within the Project area.

Meeting	Date	Venue	Stakeholders
1	15 November 2017	Baeker Town Hall	• More than 36 participants representing different sections of the community including elderly, women, youth and PAPs. • Baeker IPDC Project Office Staff • Western Tigray Zone Land management office representatives.
2	15 November 2017	Mai Kadra Town Administration Office	• More than 55 participants representing different sections of the community including elderly, women, youth and PAPs • IPDC Project Office Staff

The consultees identified the following important issues regarding the proposed IAIP and RTC development:

- The community were generally concerned with potential impacts that may result from the RTC such as how the RTC will relate to future planned development in the Town as the RTC in not included within the Town's Masterplan. Another issue raised related to the drainage system and how it is going to be incorporated into the towns plan to be prepared in the future.
- The community would like to see all employment opportunities created by the RTC primarily benefit the unemployed youths in the town rather than people who will migrate to the area in search of job opportunities.
- Some of the PAPs who were participating at the consultation meeting also mentioned that some farmers who are displaced from their land and used to have more than two hectare of land have received replacement land but some others who had less than that haven't received any and asked to get a solution.

- Concerns were raised regarding access to drinking water for livestock in the area since some of the boreholes dug to provide water to the livestock are within the proposed IAIP compound. Availability of water to the community with the IAIP in place is a concern.
- Participants raised that air pollution and soil erosion be considered as high significance.
- The PAPs who were participating at the consultation meeting mentioned that some of the big commercial farmers (investors) who are displaced from their land have received replacement land and started production. However, the small farmers have not received their replacement and therefore have not yet started production. In addition, their complaint and grievances have not yet been resolved. Some of the small farmers who obey to receive replacement land were facing problem with enforcement of their entitlement to the land over its previous users.
- A government representatives stated that, there are complains that haven't been resolved yet and they will discuss the issues with the displaced farmers and will try to solve them. It was made clear that for the PAPs who are willing to take their compensation in kind i.e. replacement land and not cash compensation, the replacement land is ready and available.

The participants from both meetings acknowledged their appreciation of 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. It is likely that a diverse range of stakeholders will be identified that could be involved in the stakeholder engagement process. Furthermore, different issues are likely to concern different stakeholders.

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 time in-between formal rounds of engagement.

A feedback mechanism was therefore in place for use 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 BASELINE OF 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 baseline or status quo environment against which environmental impacts of the proposed Project can be assessed and future changes monitored.

The information presented in Chapter 8 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 Tigray 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 Baeker IAIP site and the Mai Kadra 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); • Ground Water (Hydrogeology); • Wetlands; • Air Quality; • Noise; • Transport / Access; • Visual; • Waste Management.
Biological	• Biodiversity.
Socio-Economic	• Demographics; • Ethnicity, religion and languages; • Social Infrastructure and services; • Economy and livelihood activities; • Cultural heritage.

8.2 CLIMATE

In general the Project area has a hot, semi-arid climate. Daily meteorological data (temperature and precipitation) was obtained from the Baeker Meteorological Directorate for the Baeker meteorological station for the period January 2009 – May 2017. This station is classified as a Third Class station which measures only three meteorological elements, namely, minimum daily temperature, maximum daily temperature and total rainfall.

8.2.1 TEMPERATURE

According to the meteorological data from the Baeker station, the mean maximum and minimum monthly temperatures for the period January 2009 – May 2017 are 33.0°C and 12.8 °C, respectively (**Table 8-2**).

Table 8-2: Mean maximum and minimum temperature (°C) for the Baeker Station (2009-2017)

Station	Year	Mean	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Mean
Baeker	2009	Max	38.5	41.0	42.5	43.5	43.5	41.0	0.0	33.5	36.5	41.0	41.0	N/A	33.5
		Min	14.0	16.0	16.0	18.0	22.0	18.0	0.0	18.5	19.5	18.0	15.0	N/A	14.6
	2010	Max	38.5	42.0	42.5	43.5	42.5	40.0	36.0	33.5	38.5	37.0	38.5	38.0	39.2
		Min	13.5	16.0	15.5	22.5	22.0	20.0	19.5	19.0	18.0	19.5	16.0	13.5	17.9
	2011	Max	37.5	42.0	42.0	43.5	44.5	41.0	39.0	38.5	38.5	39.0	39.0	38.5	40.3
		Min	13.0	14.0	19.0	20.0	14.5	14.5	13.0	12.5	12.5	12.5	11.0	12.0	14.0
	2012	Max	38.0	41.5	43.0	43.0	43.0	40.0	33.0	32.0	35.0	39.0	38.5	38.0	38.7
		Min	12.0	15.5	17.0	17.0	18.5	16.5	14.5	18.0	16.5	16.5	15.0	13.5	15.9
	2013	Max	39.5	42.0	42.0	43.0	42.0	41.0	36.5	33.5	36.0	38.5	38.0	37.5	39.1
		Min	13.5	14.0	18.5	17.5	20.0	18.0	16.5	16.5	17.5	16.0	15.0	12.0	16.3
	2014	Max	36.5	41.5	41.5	43.5	44.0	41.5	41.5	40.0	39.5	38.5	40.5	N/A	37.4
		Min	13.0	17.5	16.0	2.0	15.0	15.5	12.5	13.0	14.0	16.0	N/A	N/A	11.2
	2015	Max	41.5	41.5	42.0	42.0	44.0	41.5	40.0	37.0	35.5	N/A	N/A	N/A	30.4
		Min	4.0	4.0	10.5	16.0	16.5	16.0	16.5	17.5	17.5	N/A	N/A	N/A	9.9
	2016	Max	37.6	43.8	46.4	45.2	45.0	46.2	N/A	N/A	N/A	N/A	N/A	N/A	22.0
		Min	10.4	11.4	18.6	19.8	18.0	16.2	N/A	N/A	N/A	N/A	N/A	N/A	7.9
	2017	Max	38.8	38.8	39.8	39.8	39.2	N/A	N/A	N/A	N/A	N/A	N/A	N/A	16.4
		Min	12.8	15.2	16.0	22.6	22.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	7.4

Note: N/A = Not Available

8.2.2 PRECIPITATION

The precipitation across Ethiopia varies depending on the altitude with hot and arid climate being experienced in the lowlands and cool climate on the plateau. The Tigray region is located predominantly within the arid region. Within this region the total rainfall regularly drops below 700 mm per year.

The total annual rainfall for the Baeker town area, for the period January 2009 – May 2017, ranges from 93.1 mm to 1295.3 mm (**Table 8-3**).

Table 8-3: Annual rainfall (mm) for the Baeker Station (2009-2017)

Station	Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total Annual
Bure	2009	0.0	0.0	0.0	2.0	21.3	88.5	0.0	132.1	73.0	24.7	0.0	0.0	341.6
	2010	0.0	0.0	0.0	30.9	63.3	206.7	265.5	224.2	167.9	37.8	0.0	0.0	996.3
	2011	0.0	0.0	0.0	0.0	67.8	117.5	90.3	89.5	55.1	84.9	0.0	0.0	505.1
	2012	0.0	0.0	0.0	0.0	24.0	192.1	177.5	338.0	174.7	30.7	9.6	0.0	946.6
	2013	0.0	0.0	0.0	0.0	50.7	129.4	164.4	189.2	96.3	54.2	0.0	0.0	684.2
	2014	0.0	0.0	1.2	53.0	26.0	98.7	362.3	440.5	262.2	51.4	0.0	0.0	1295.3
	2015	0.0	0.0	0.0	0.0	87.0	55.1	97.7	317.7	55.3	0.0	0.0	0.0	612.8
	2016	0.0	0.0	10.7	0.0	11.5	121.3	0.0	0.0	0.0	0.0	0.0	0.0	143.5
	2017	0.0	0.0	0.0	11.5	81.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	93.1

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;
- 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).

The federal highway which connects Gondar and Humera abuts the proposed site.

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 is used by nearly all Ethiopian households (95%), with the vast majority (85%) using firewood for cooking (**Table 8-4**). 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 (WMS, 2011).

Charcoal is the second most frequently used type of fuel (18%) 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 (WMS, 2011).

Table 8-4: Household energy use for cooking in Ethiopia (WMS, 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 (Biomass)	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.

8.3 TOPOGRAPHY AND GEOMORPHOLOGY

8.3.1 BAEKER IAIP

The Baeker IAIP is situated on an extensive flat plain bounded to the north and northeast by volcanic ridges. Although the natural physical features are obscured by human activities, there are, in places, volcanic domes (ridges) forming relatively elevated peaks within the vast plain on a regional basis.

A detailed topography survey of the site was carried out by MACE during October and November 2016. In general, the topography of the site varies between +719.00m to +676.00m with undulations at some portions of the site. The site gently slopes from the centre of the site towards North, West and Southwest directions. (**Figure 8-1**)

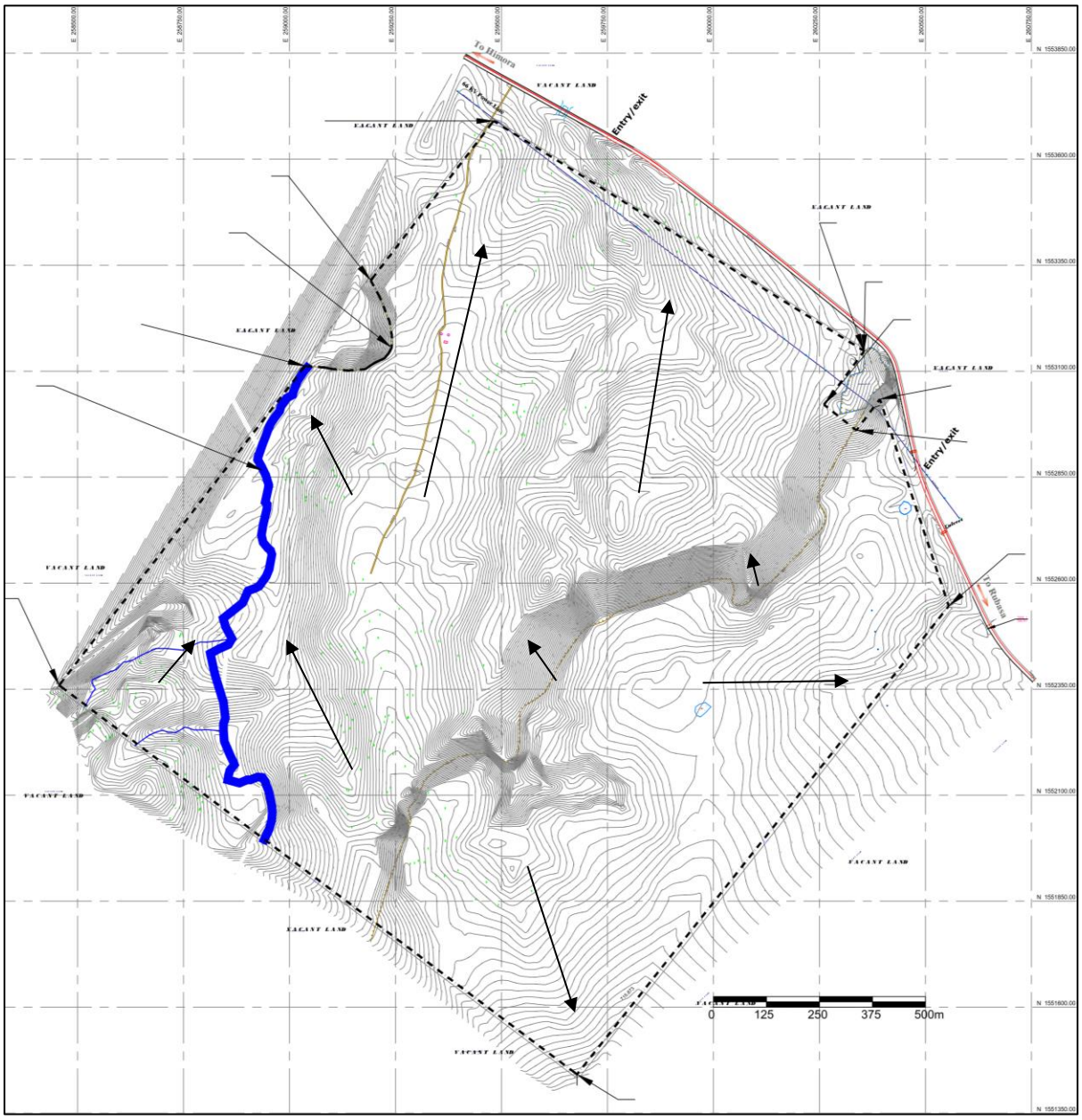

Figure 8-1: Topography survey drawing of the IAIP site indicating predominate slope (Source: MACE)

8.3.2 MAI KADRA RTC

A detailed topography survey was carried out by MACE during the month of October 2016 (**Figure 8-2)**. In general, the topography of the site varies between +624.699m to +620.573m and the site gently slopes from Northwest to Southwest.

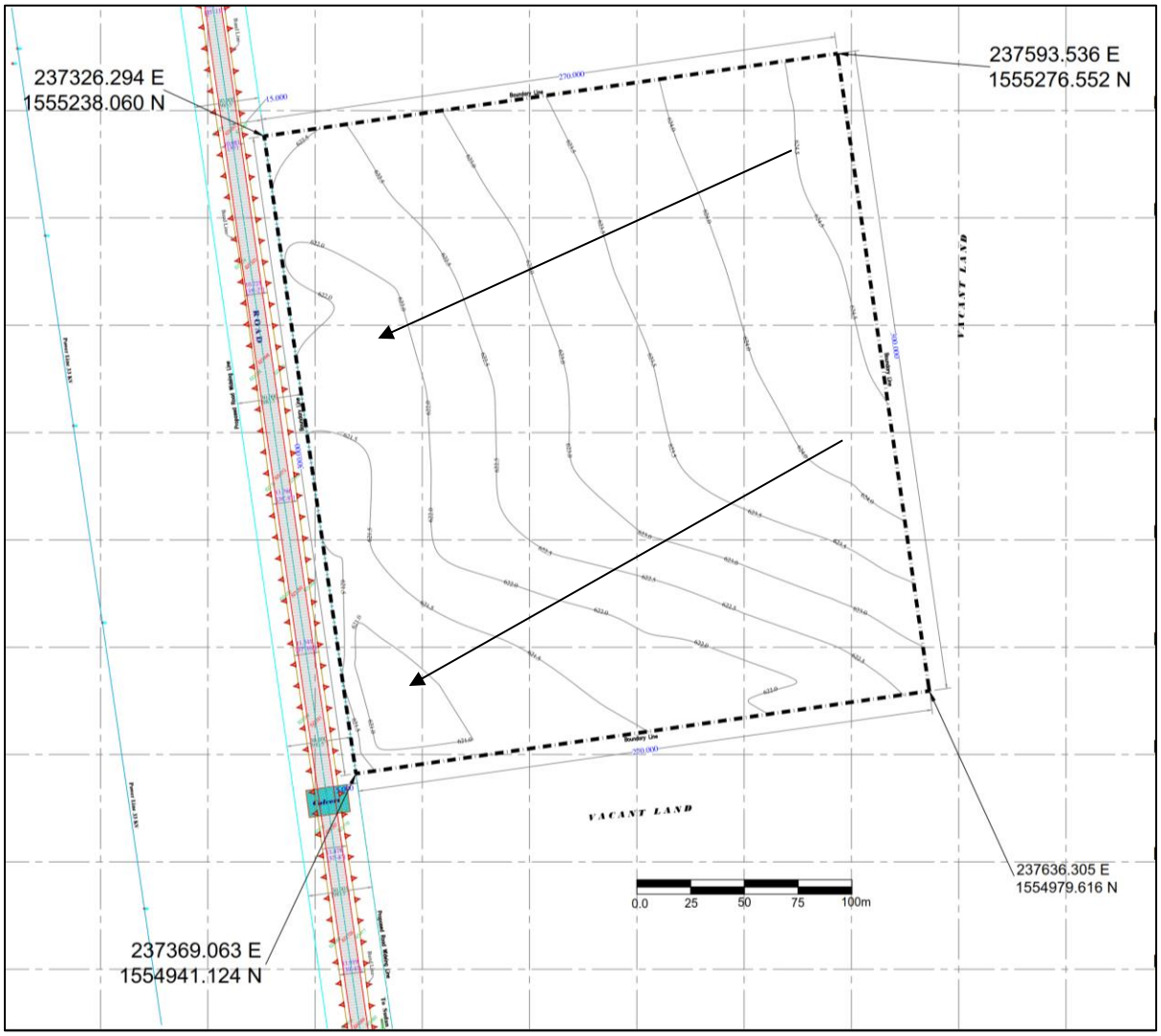

Figure 8-2: Topography survey drawing of the RTC site indicating predominant slope (Source: MACE)

8.4 GEOLOGY

The Tigray region is reportedly rich in high quality marble and gold deposits although the exact quantity of these deposits is not well known. Gold mining in the region has traditionally been a primary source of income for the local population. The extraction of gold occurs in an informal manner and is more aligned with artisanal or subsistence mining, where the individuals are not officially employed by a mining company, but rather work independently (Studio Samson Addis Consulting Architects, Planners and Engineers, 2012). In contrast to this, the marble is being mined by private companies in the area and it is serving as major source of income.

According the Seismic map of Ethiopia Baeker town is located far away from the main Ethiopian rift, which is the major seismic zone of the country as well as the world (National Atlas of Ethiopia, 1988). Hence, the area is situated within the zero seismic zone and damages related to tectonic activities are not expected.

8.4.1 BAEKER IAIP

The geology of northern Ethiopia, particularly Tigray, is represented by rocks ranging in age from Precambrian to Cenozoic and by the recent soil covers of quaternary alluvial/elluvial deposits. Oldest rocks of the area include Tsaliet and Tembien group metavolcanics and metasediments.

The project area is located northwest of Baeker Town and is generally covered with the Triassic – Jurassic clastic rocks named Sandstone (Adigrat sandstone) interbeded with relatively thick mudstone, the oldest rock in the area stratigraphically overlain by the tertiary volcanic rocks of the Semien Mountains of the Ethiopian highlands. The Sandstone-mudstone formation in the area is medium to coarse grained, unsorted, immature and with irregular sized grains intercalated with variegated to whitish coloured mudstones. The thickness of this formation is expected to be more than 200m (i.e. based on borehole litho logs drilled 5kms southeast of the town and assumptions from geophysical survey).

The boreholes located south east of the town i.e. Baeker Deep well-2 and 3 are penetrated up to 8 and 4 meters in the alluvium, from 18-14 meters in the basalt and up to 174-140 meters in the Mudstone and SST respectively. The underling formation i.e. the basement is not encountered. **Figure 8-3** shows a schematic geological map of the study area geology.

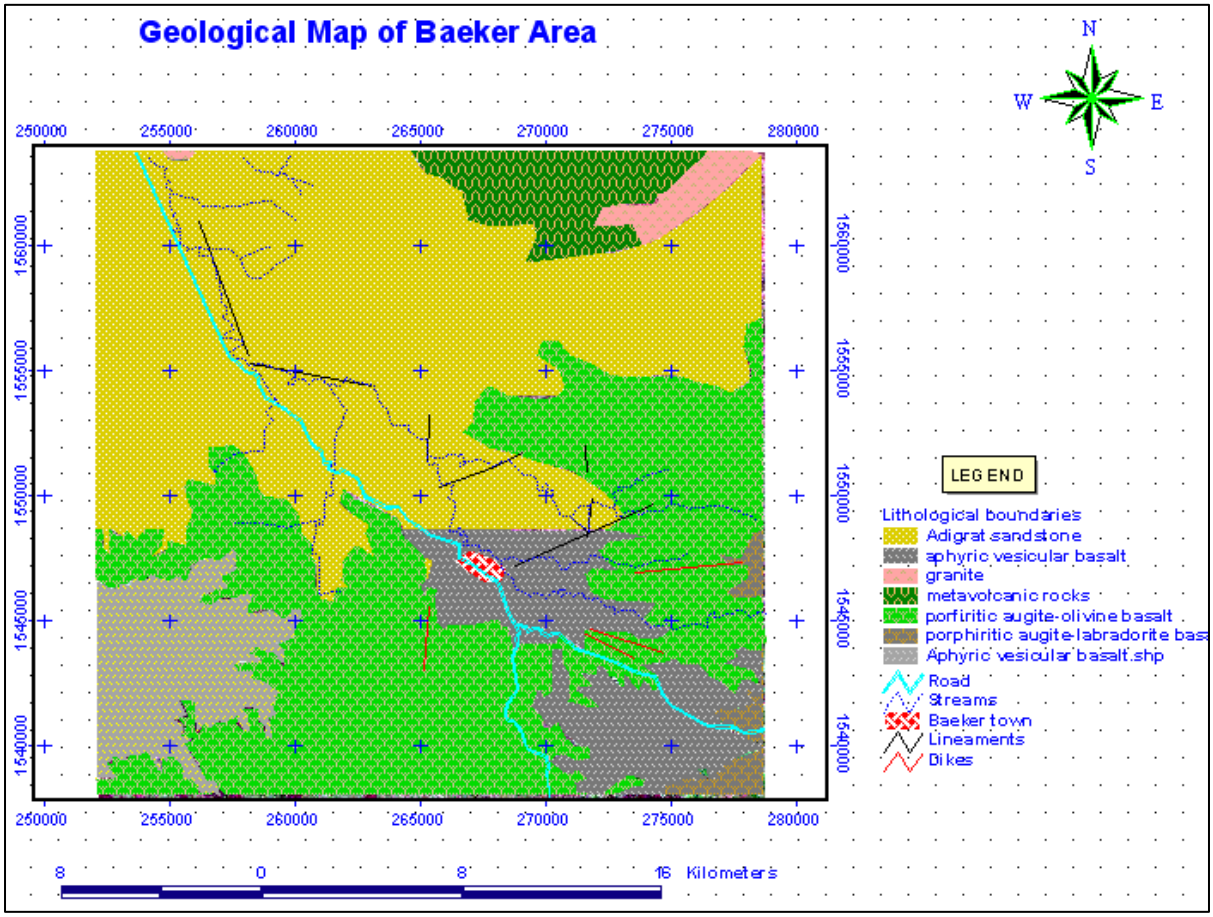

Figure 8-3: Geological Map of the Tigray area

Geologic logs of wells around the study area (Baeker and Kafta) indicate that there are tertiary basaltic volcanic rocks such as the vesicular basalt, Porphyiritic augite-Olivine basalt, Porphyiritic augite- Labradorite basalt and Aphyric vesicular basalt. The aerial extent of this rock is small and limited to the top of hills and comparatively higher land of the area. The rocks play an important role in recharging the area especially where structurally affected by the NE-SW faults and fractures. But there is limited exposure of this rock in the irrigable area and do not play an important role as a groundwater reservoir.

A brief description of the primary deposit found on the IAIP site as indicated on the map is provided below.

ADIGRAT SANDSTONE

The unit is identified in deep cut gullies and gorges of the surrounding creeks and streams. In the vast plain of the town the presence of thick quaternary deposit conceals them. The presence of repetitive cycles of inter-layering in the rocks are believed to be deposited either in lacustrine or fresh water conditions. The presence of sandstone in the unit also depicts the gradual change of paleo-environment from terrestrial to fluvial lacustrine and fresh water conditions. The degree of consolidation and compaction is weak hence the rocks are prone to weathering. Average observable thickness of these rocks varies from 10m to 15m. Fresh white to pink and light reddish weathered colours characterize the subunits.

8.4.2 MAI KADRA RTC

South of Mai Kadra town there are outcrops of highly fractured and moderately fractured mudstone-sandstone intercalations overlain by remnant cap rocks of basalt. These sedimentary rocks are horizontally embedded and compacted. **Figure 8-4** shows the location of Mai Kadra town in relation to the local geology.

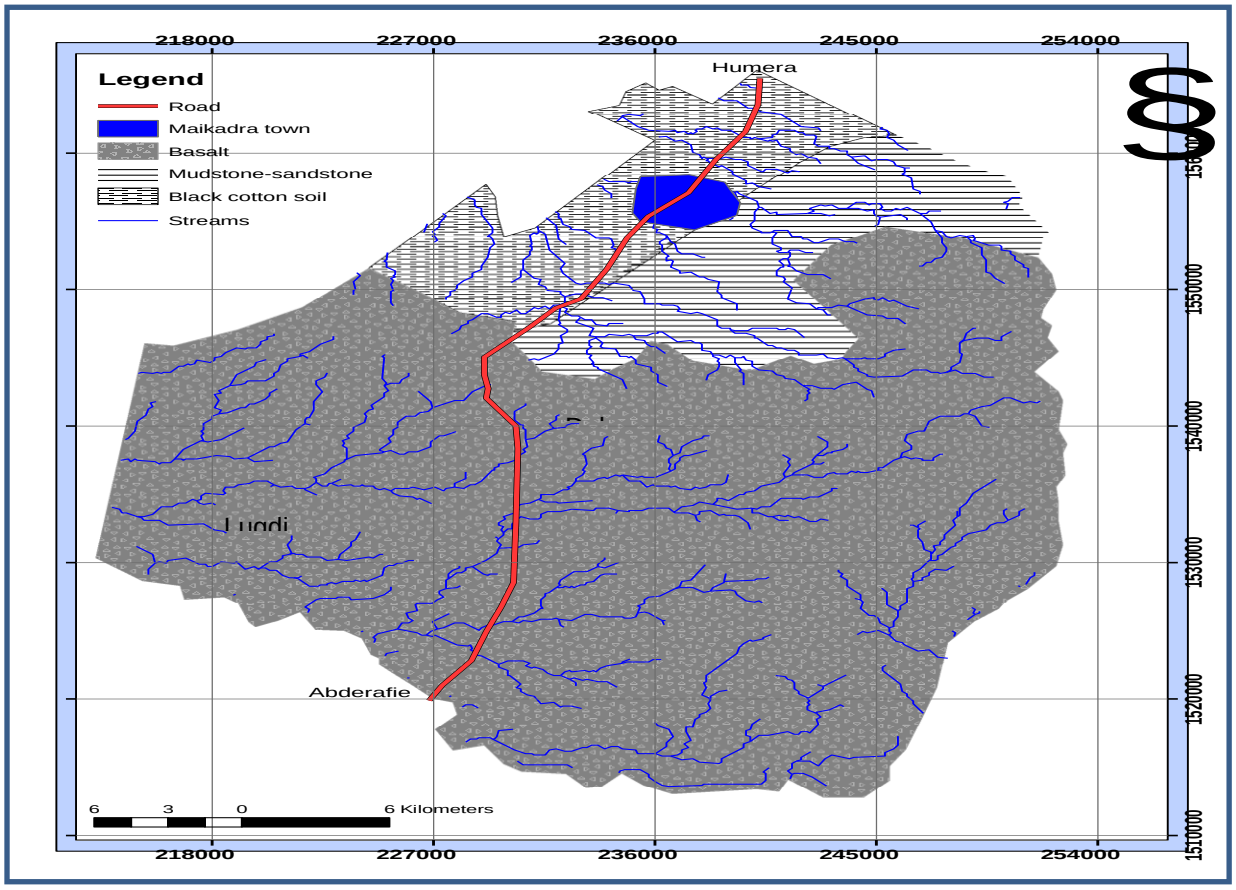

Figure 8-4: Geology encountered beneath the Mai Kadra site

The Project area is covered by a black cotton soil. According to the lithological log of a borehole drilled in the area it is underlain by basaltic rocks up to 18m followed by mudstone-sandstone intercalations.

BLACK COTTON SOIL

The Mai Kadra project area including the Mai Kadra town is totally is extensively covered with fine grained compact dark grey Black cotton soil (clay) which could go up a depth of 2 to 3 meters deep This in turn is underlain by medium, unsorted, and immature and with irregular sized grains intercalated with variegated to whitish coloured mudstone and with gravel at places.

MUDSTONE - SANDSTONE

This formation was also observed during the drilling process of the borehole, adjacent to the project area. These formations cover large thickness of the total depth of the borehole inter bedded with the Sandstone believed to be the Adigrat sandstone (from 66m-102m). This formation has a predominantly white colour due to the quartz and is observed at different depths from 60m-66m, 90m-98m and 102m up to the final depth of the borehole.

8.5 SOILS

A detailed desktop assessment was undertaken for the Tigray 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 Tigray region.

The dominant soil types in the influence area are vertisols, cambisols, nitosoles and luvisols. Of which vertisol roughly accounts for more than 50% of the total area in the influence region is found to be the dominant soil type.

8.5.1 SITE ASSESSMENT

Site visits were conducted from 28 to 31 August 2017 at the Tigray IAIP and RTC sites. Soil survey, classification, field mapping and sample analysis was 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, 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 Tigray region and the land uses identified on site were noted and mapped.

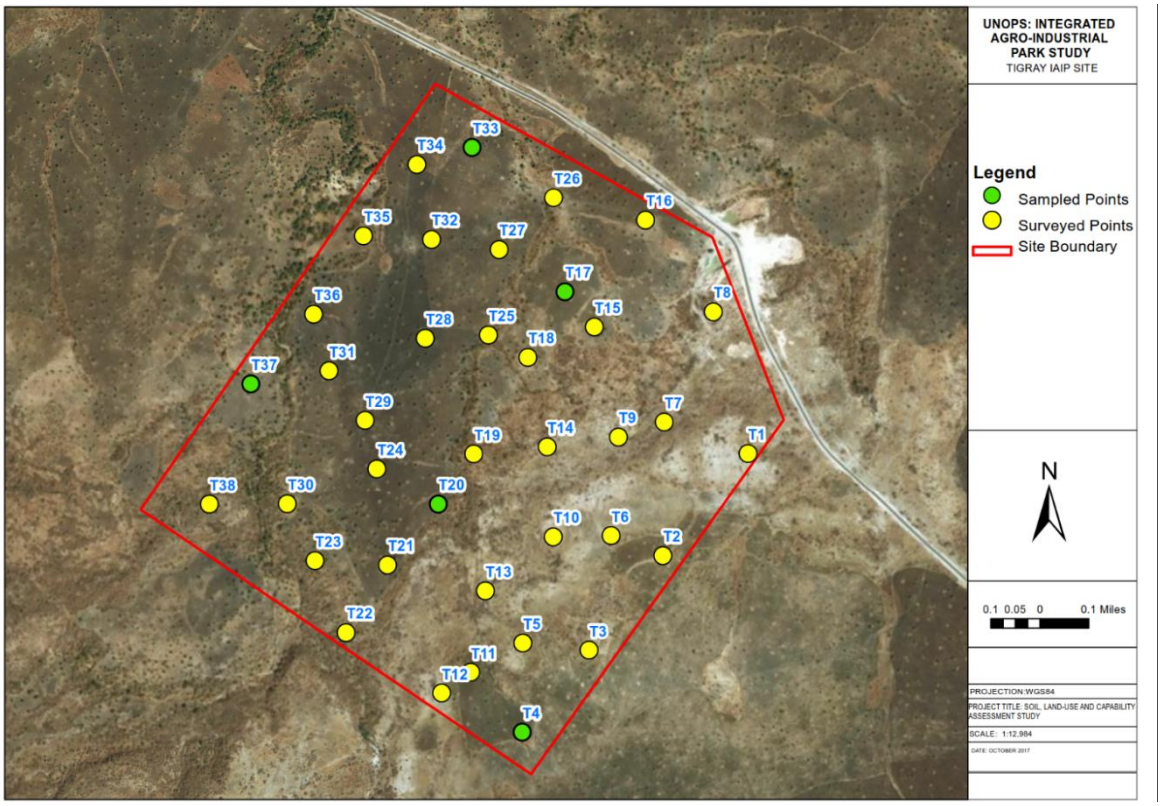

Figure 8-5: Pre-determined survey points for Tigray Baeker IAIP site.

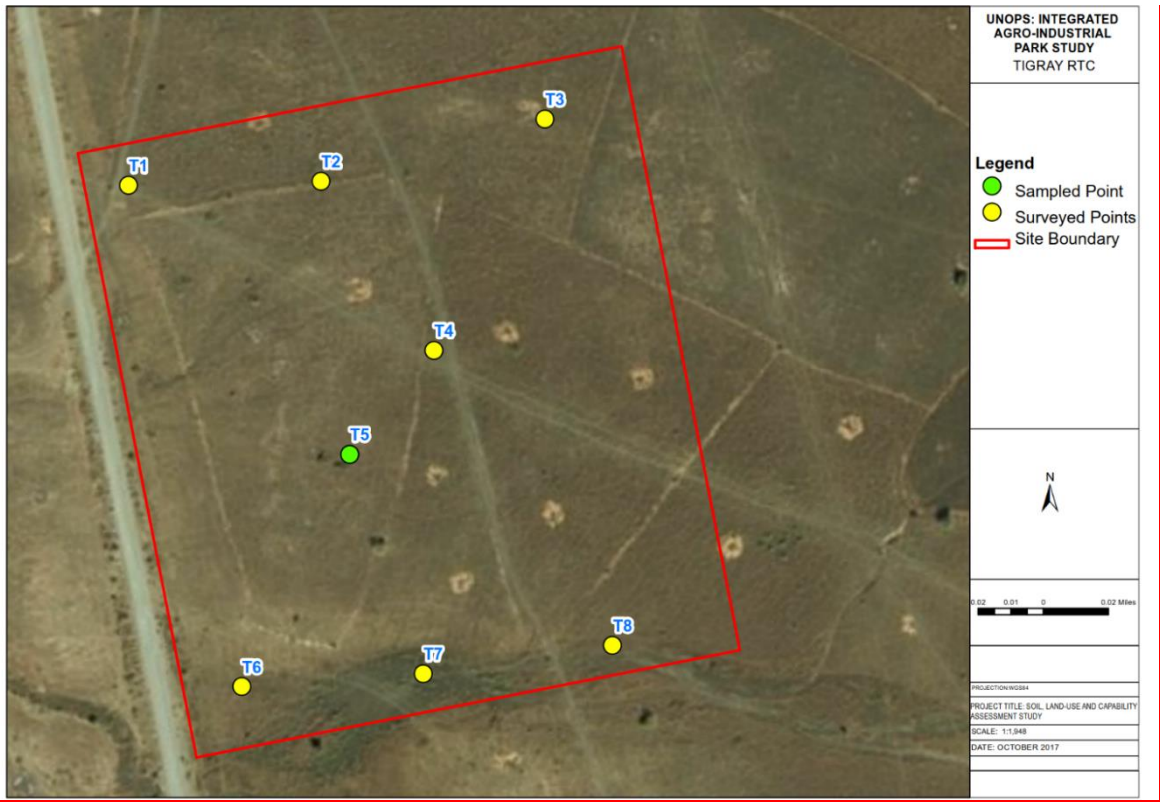

Figure 8-6: Pre-determined survey points for Mai Kadra RTC site

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 8-5**). 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 8-5: 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.

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.
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), Luvisols, Alisols and Retisols dominate the Tigray IAIP and RTC sites.

8.5.4 BAEKER IAIP

DESKTOP REVIEW

The ISRIC World Soils Database shows that the Tigray IAIP site to be dominated by Luvisols, Alisols and Retisols. These have an average particle size distribution of 45% sand, 21% silt and 34% clay, which works out as an average texture classification of a Sandy Loam soil (USDA, 1939). 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 characterised 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 Calcium (Ca) present in the parent material (J.A. 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. Aluminium (Al) dominates the exchange complex (FAO, 2001) and they are poorly drained soils with a dense subsurface clay layer, which causes a relatively high concentration of Al ions in the root zone. Alisols occur mainly in tropical and humid subtropical climates. Alisols' high acidity is increased by limited drainage and they thus need liming. They contain few nutrients and therefore need fertilizer, and do not have much surface coherence so are easily eroded. Al and Manganese (Mn) 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. 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).

According to the preliminary geotechnical assessment undertaken for the Tigray study (MACE, 2016), both the Tigray IAIP and RTC sites comprised soils that consist of black, soft to medium stiff, highly plastic, silty clay with traces of sand.

LAND USE ASSESSMENT

At the Tigray IAIP site, the majority of the usable land is under crop production. Areas not being utilised for crop production include the drainage line and a small camp area.

SOIL CLASSIFICATION

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.

MILKWOOD / LEPTOSOL SOILS

The Milkwood soil form was identified over 135 ha or 52% of the Tigray IAIP site (see **Figure 8-7**). This soil is characterised by a Melanic A horizon over hard rock. **Figure 8-7** shows a photograph taken during the soil survey of the dark Melanic A horizon around the auger hole, and the gravelly hard rock on the plastic sheet. The Milkwood soil form falls into the South African Melanic soil group. These dark coloured, strongly structured, high base status soils are similar to the dark Vertic soils but are physically more subdued for textural or mineralogical reasons. The Milkwood soil form is similar to the WRB Leptosols soil group (Fey, 2010). Leptosols are soils with a very shallow profile depth (indicating little influence of soil-forming processes), and they often contain large amounts of gravel. They typically remain under natural vegetation, being especially susceptible to erosion, desiccation, or waterlogging, depending on climate and topography.

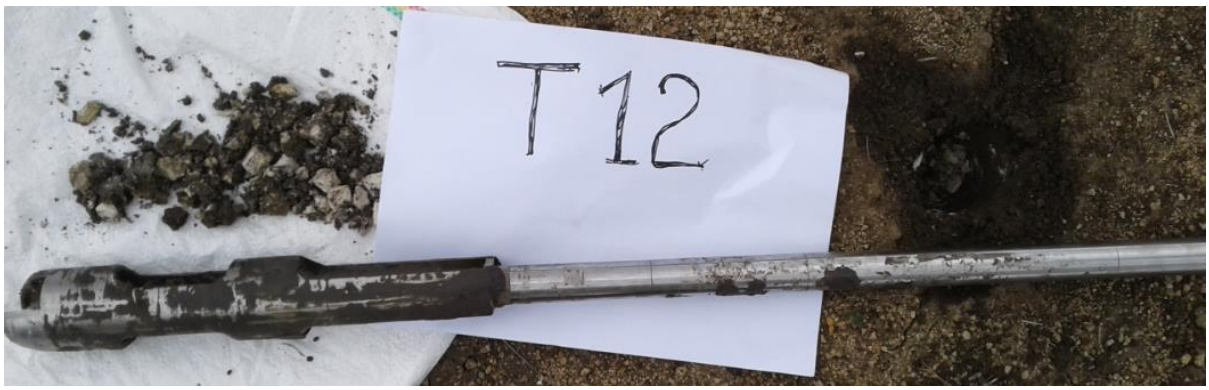

Figure 8-7: Photograph showing Milkwood / Leptosol soil – Tigray IAIP site

The Bonheim soil form (see **Figure 8-8**) was identified over 125ha or 48% of the Tigray IAIP site. This soil is characterised by a Melanic A horizon over a pedocutanic B horizon. The pedocutanic B horizon is a layer enriched with clay as a result of illuviation and has developed a blocky structure. The Bonheim soil form also falls into the South African Melanic soil group. As mentioned, according to the World WRB Classification system (WRB, 2006), the Tigray IAIP site is dominated by Luvisols, Alisols and Retisols. Luvisols are technically characterized by a surface accumulation of humus overlying a clay illuviation horizon, and 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). The Bonheim soil is clearly similar to Luvisol soils.

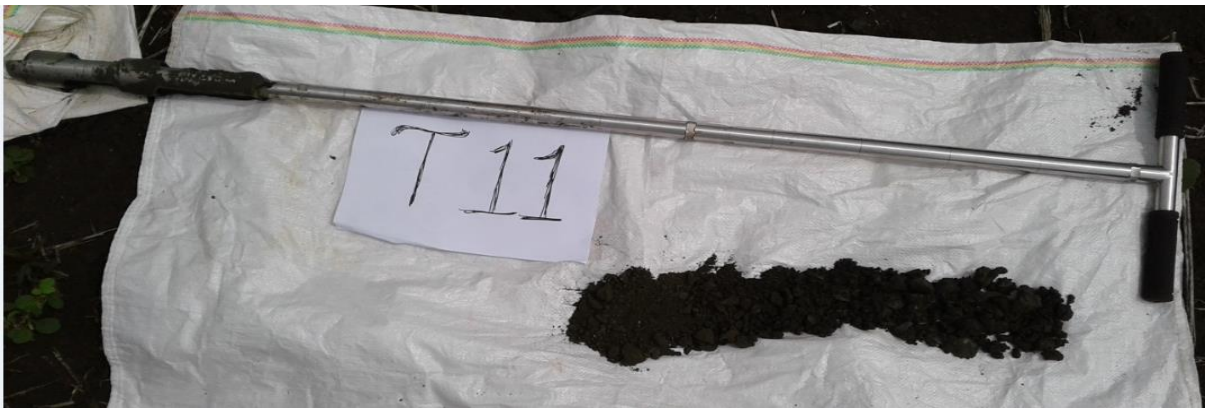

Figure 8-8: Photograph showing Bonheim / Luvisol soil profile – Tigray IAIP site

The distribution of the soils forms at the IAIP site can be seen in **Figure 8-9**.

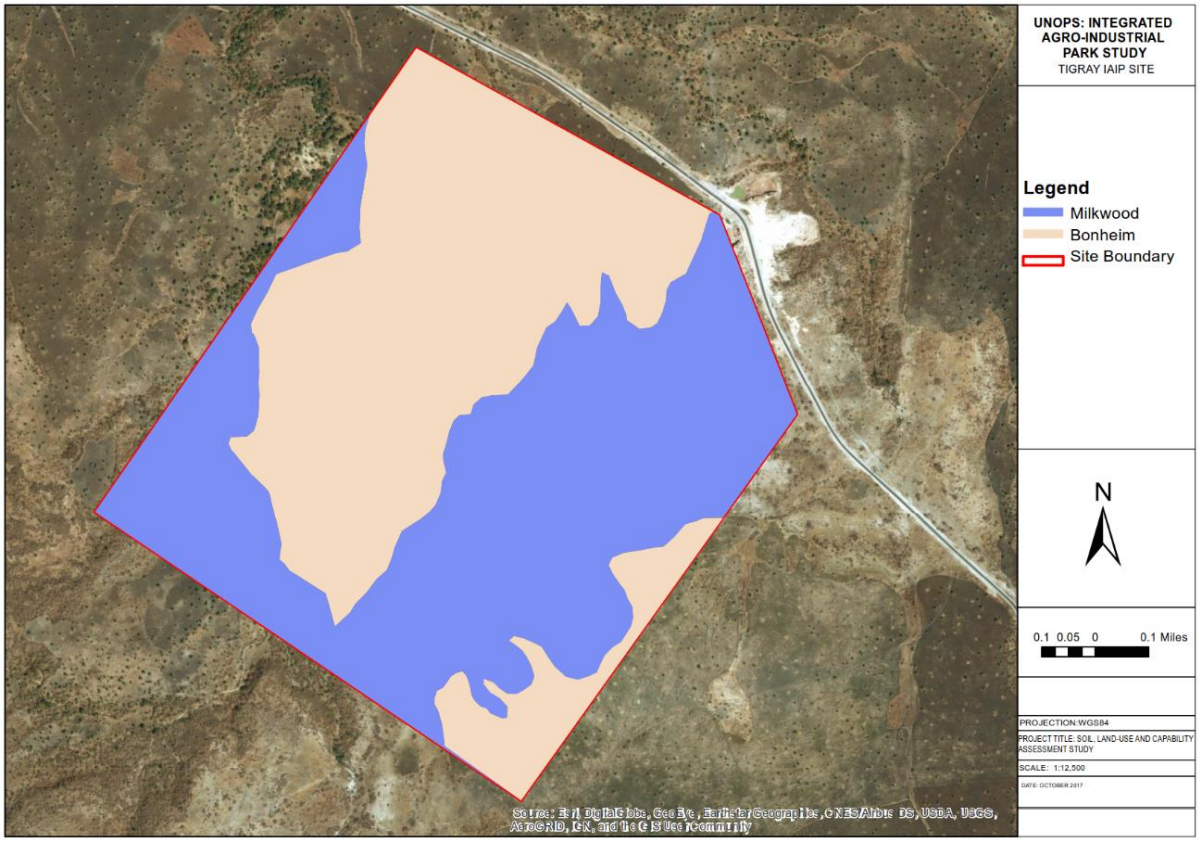

Figure 8-9: Distribution of the soil forms at the IAIP site

SOIL CAPABILITY ASSESSMENT

The soil profiles at the study site indicated mostly shallow to very shallow soils at the auger points assessed. Melanic soils are associated with a semi-arid to sub-humid climate and are fertile but require irrigation to be highly productive. Natural veld on these soils provides sweet grazing. Although their structure is strong, it is less stable than in humic soils and the soils may be more erodible. Melanic soils are well buffered and can be cropped intensively without needing lime to counteract acidification.

Using the South African soil classification guidelines (Scotney *et al.,* 1987), the land capability of the Bonheim soils was established as Land Capability Group 'Arable Soils' and Land Capability Class II, as it has 'Slight limitations' and 'Low erosion hazards' and can be used for (in order of increased intensity of use) 'Wildlife, Forestry, Light Grazing, Moderate Grazing, Intensive Grazing, Light Cultivation, Moderate Cultivation and Intensive Cultivation' (Table 8.1, Scotney *et al.*, 1987). In the context of the Tigray sites, this is accurate in that these Melanic soils do pose a low erosion hazard and pose no structural impediment to roots, but the lack of financial resources in the area and the limited soil depth highlight that these soils pose moderate limitations to growth. The Bonheim soil areas were thus allocated a soil capability class of III. The Bonheim soil form is typically fertile, well-buffered and easily managed, and thus a high yielding soil. These soils can still pose a risk to engineered structures as they do contain some shrink-swell clays (Fey, 2010).

Using the South African soil classification guidelines (Scotney *et al.,* 1987), the land capability of the Milkwood soils was established as Land Capability Group 'Wildlife' and Land Capability Class VIII as it has 'Extremely severe limitations' and is 'not suitable for grazing or afforestation'. This is accurate in the context of the Tigray site as these soils are extremely shallow.

The distribution of land capability classes can be seen in **Figure 8-10**.

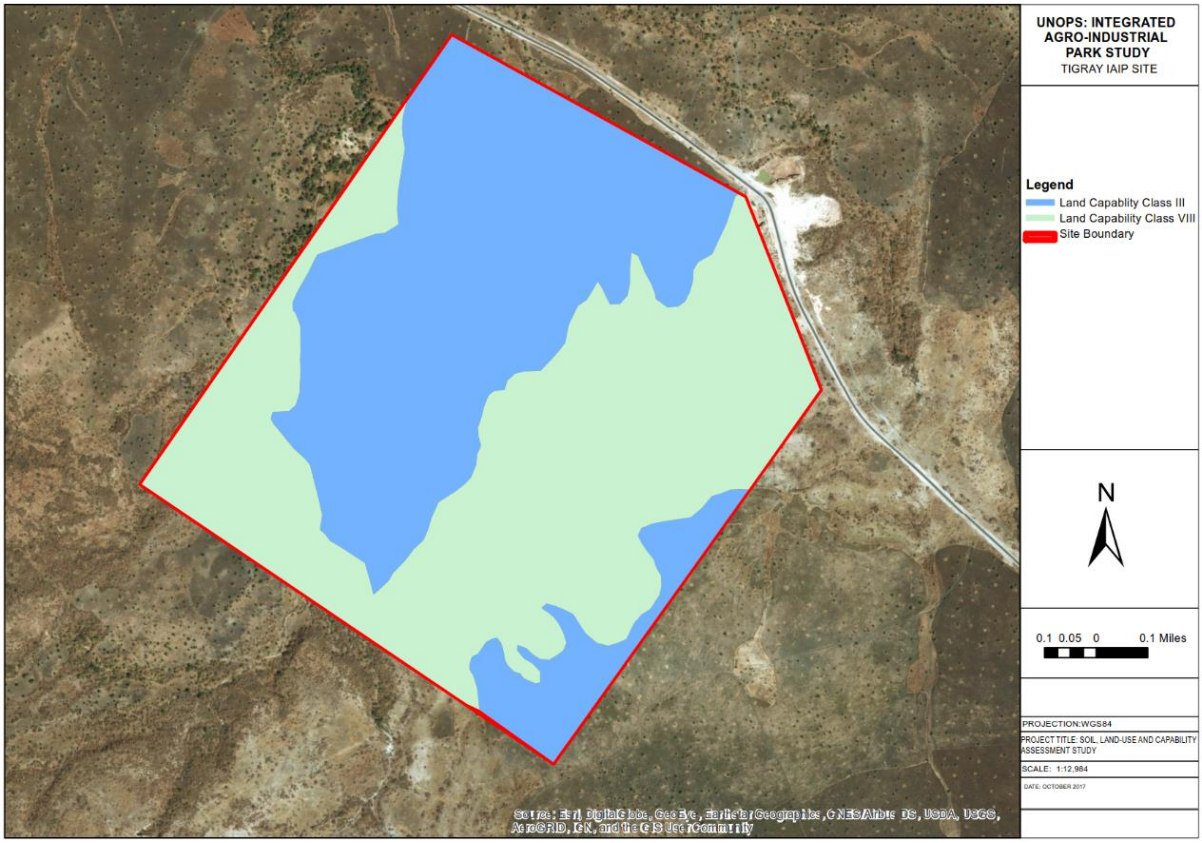

Figure 8-10: Distribution of land capability classes at the Baeker IAIP site

8.5.5 MAI KADRA RTC

DESKTOP REVIEW

The ISRIC database shows the Mai Kadra RTC site to be dominated by Luvisols, Alisols and Retisols, as described in Section 8.5.4.

LAND USE ASSESSMENT

At the Mai Kadra RTC site 100% of the area is used for crop production.

SOIL CLASSIFICATION

SHORTLANDS/LUVISOL SOILS

Soils that could be described as Shortlands (Oxidic) soils in the South African classification system were identified over 100% of the Mai Kadra RTC site. This soil is characterised by an Orthic A horizon over a red structured B horizon. **Figure 8-11** shows a photograph taken during the soil survey of the structured B horizon on the plastic sheet, with the Orthic A horizon in the background. Oxidic soils are characterised by iron enrichment. Shortlands soils can be considered similar to Luvisols.

Figure 8-11: Photograph showing Shortlands / Luvisol soil profile – Tigray RTC site

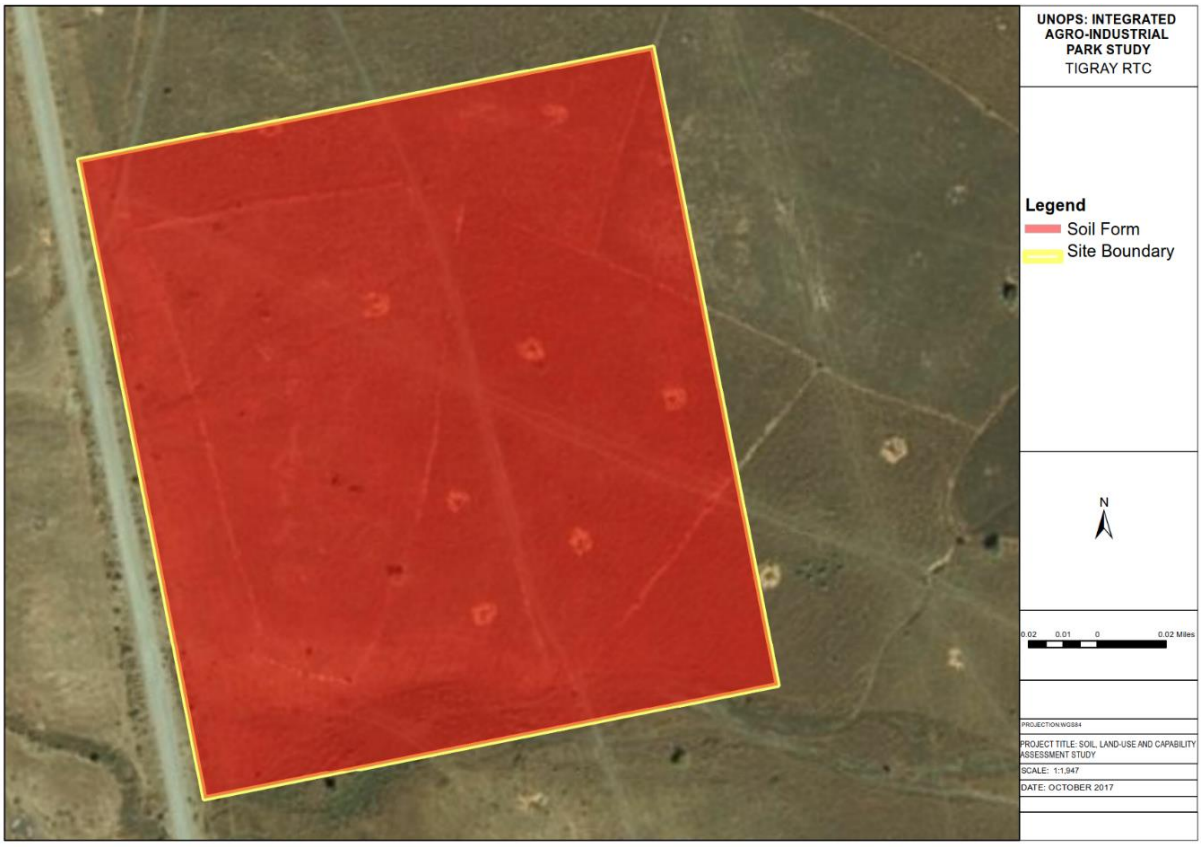

Figure 8-12: Layout showing the soil form of the Mai Kadra RTC site.

SOIL CAPABILITY ASSESSMENT

The soil profiles at the study site indicated mostly moderately shallow soils at the auger points assessed.

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; 'Slight 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 Tigray RTC 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. The distribution of land capability classes at the RTC site can be seen in **Figure 8-13**.

Figure 8-13: Figure showing distribution of land capability classes at the Mai Kadra RTC

8.6 SURFACE WATER (HYDROLOGY)

The Tigray IAIP and RTC sites are situated within the Tekeze River Basin, which spans an area of 82,350 km^2, covering parts of the Amhara and Tigray regional states. There are two main tributaries (Angereb and Goang) that contribute to Tekeze River which rises in the central highlands of Ethiopia, and joins the lower course of which is a tributary of the Nile. The river basin has a lowest elevation of 536 m and a highest elevation of 4517 m. The total mean annual flow from the river basins is estimated to be 8.2 Billion Metre Cubes (BMC) (see **Figure 8-14**). The Welkait uplands are the principal sources of recharge for the low lying areas in Humera and Mai Kadra. Most of the precipitation falls on these mountains and supplies the rivers which recharge the aquifers throughout the area.

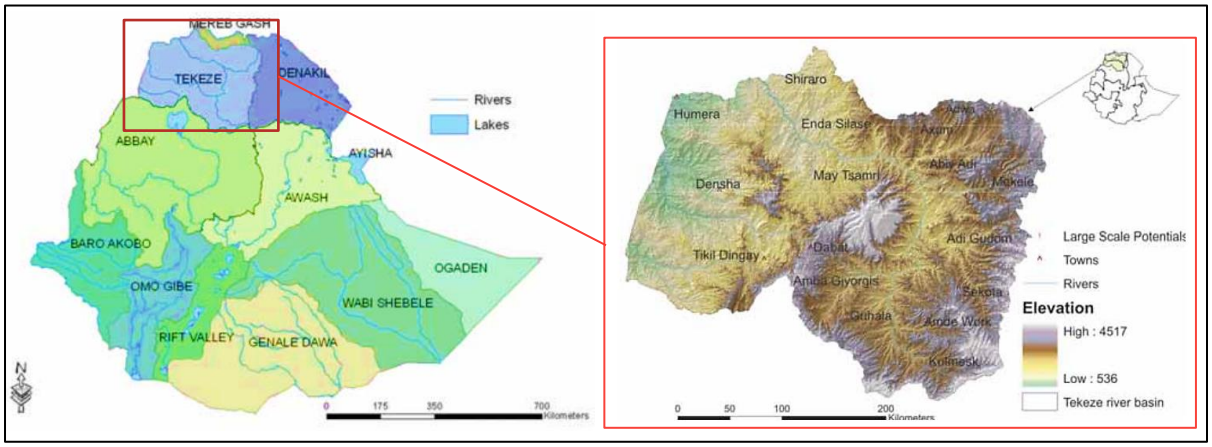

Figure 8-14: Layout showing the Tekeze River Basin, Ethiopia

8.6.1 BAEKER IAIP

During the raining season there is a watercourse, the Semina River, which is located across the western corner of the IAIP site. This is not a regular watercourse but rather a flood channel that drains storm water from the area after rainfall. There is also a second larger, much wider, flood channel present on the site which is evident by a large erosion gulley running from the southwest to the north west of the site. In order to avoid flooding of the site due to the above topography, cut-off drains will need to be provided for collecting the runoff and diverting it to a suitable discharge point. Visible erosion in the area highlights the anticipated volumes and velocities of this water during the rainy season.

The Tigray Baeker IAIP site is situated approximately 4 km away from the Bombeia River which drains into the Pawiyan Shet River which then flows into the Tekeze River. Seven water points were proposed for surface water quality sampling and five of the points were dry during the site assessment.

At the Baeker IAIP site, the Semina River is dry for most of the year and there was no flowing water visible during the site visits (see **Figure 8-15**). It is identified to be a flood channel that drains the area during rainfall; thus no samples nor measurements were taken. There is a small spring at the borrow pit site of the silicified sandstone, situated within the Beaker IAIP near the main tarmac highway (**Figure 8-16**). One surface water sample was taken at the spring. The Bombeia River (**Figure 8-17**), which is found approximately 4 km northwest and parallel of the Baeker IAIP, flows from the high lands of the Baeker area to the south. Many flood channels in the area, including from the IAIP, drain into this river; however, it gets dry even after a day from rainy weather.

Figure 8-15: Photos showing a dry flood channel in Tigray Baeker IAIP

Figure 8-16: Photo showing the borrow pit situated at the northern point of the site boundary along the highway at the Tigray Baeker IAIP

Figure 8-17: Photos showing an upstream and downstream view of the Bombeia River at the Tigray Baeker IAIP

The Mean Annual Precipitation (MAP) expected at the project site is approximately 700 mm with the wettest months occur during June, July and August and the driest months occurring during November, December and January. Surface water monitoring sites were limited around the site due to a lack of flowing watercourses within close proximity to the site. The closest flowing river in the area of the IAIP site is the Bombeia River. The river is reported to be the major river that drains from Baeker Town area and flows north towards the Rawyan area. Many of the small dry flood channels are reported to converge into this river and it is found downstream from the IAIP. All streams around the Tigray RTC site were dry and no surface water sampling was undertaken. As a result one surface water sample was taken from the Bombeia River and one from the spring (**Table 8-6**).

Table 8-6: Baeker IAIP surface water point summary and in-field measurements

Surface Water Points	Easting	Northing	Type	pH	Temp (ºC)	TDS (mg/l)	EC (µs)	DO (mg/l)
SW1	260358	1553061	Spring	7.61	30	113.2	223.6	5.25
SW2	257570	1555955	River	8.23	33.6	120.4	240	5.45

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.

A water quality assessment was undertaken by MACE which referred to the Geological Survey of Ethiopia (GSE) Hydrogeological and Hydro chemical maps of AdiRamet- ND 37-9 and ND37-5 sheets. This survey was conducted by appropriate officials and a total of 224 samples was collected from various locations around Western Tigray. The assessment concluded that the general water quality within Western Tigray was of acceptable limits, see **Table 8-7**. TDS was the only factor that exceeded the Ethiopian permissible and acceptable limit. (MACE, 2017)

Table 8-7: Water Quality Results for Tigray IAIP (Baeker)

Test	Units	LOD	Ethiopian Standard	WHO Guidelines	SW01	SW02
Dissolved Aluminium	ug/l	<20	200	100	<20	<20
Dissolved Antimony	ug/l	<2	-	20	<2	<2
Dissolved Arsenic	ug/l	<2.5	10	10	<2.5	<2.5
Dissolved Barium	ug/l	<3	700	700	382	18
Dissolved Boron	ug/l	<12	300	500	<12	16
Dissolved Cadmium	ug/l	<0.5	3	3	<0.5	<0.5
Total Dissolved Chromium	ug/l	<1.5	50	50	<1.5	<1.5
Dissolved Copper	ug/l	<7	2000	2000	11	<7
Total Dissolved Iron	ug/l	<20	300	-	<20	<20
Dissolved Lead	ug/l	<5	10	10	<5	<5

Test	Units	LOD	Ethiopian Standard	WHO Guidelines	SW01	SW02
Dissolved Manganese	ug/l	<2	500	400	<2	<2
Dissolved Mercury	ug/l	<1	-	6	<1	<1
Dissolved Nickel	ug/l	<2	-	70	<2	<2
Dissolved Selenium	ug/l	<3	-	10	<3	<3
Dissolved Sodium	mg/l	<0.1	200	40	7.3	6.7
Dissolved Uranium	ug/l	<5	-	15	<5	<5
Dissolved Zinc	ug/l	<3	5000	3	<3	<3
Fluoride	mg/l	<0.3	1.5	1.5	0.4	<0.3
Sulphate as SO_4	mg/l	<0.5	200	-	10.7	4.9
Chloride	mg/l	<0.3	250	-	10.7	3.1
Nitrate as N	mg/l	<0.05	50	50	1.66	0.73
Nitrite as N	mg/l	<0.006	3	3	<0.006	<0.006
Total Cyanide	mg/l	<0.01	70	70	<0.01	<0.01
Electrical Conductivity @25°C	uS/cm	<2	-		198	182
Free Ammonia as N	mg/l	<0.006	1.5	1.5	<0.006	<0.006
Free/Residual Chlorine	mg/l	<0.02	0.5	5	0.02	<0.02
pH	pH units	<0.01	6.5 - 8.5	6.5 - 8.5	7.65	7.59
Total Dissolved Solids	mg/l	<35	1000	600	196	192
Turbidity	NTU	<0.1	-	5	9.4	33.2

8.6.2 MAI KADRA RTC

There are no surface water features located on the Mai Kadra RTC site. There is however a drainage channel running to the south of the south western corner of the site. There was no visible flow of water in this channel during any of the site visits and it is therefore considered to be a flood channel. No surface water monitoring could be undertaken at this site given the lack of surface water features, however Table 8-7 above provides water quality data for the Western Tigray Region and can be used as an indicator of surface water quality at the Mai Kadra RTC site.

8.7 GROUNDWATER (HYDROGEOLOGY)

8.7.1 OVERVIEW

Within the Tekeze River Basin the hydrogeological behaviour of the volcanic rocks deposits and the hydro chemical signature of natural waters are diversified and influenced by the:-

- Wide compositional, structural and textural variability of the volcanic rocks;
- Complex spatial and temporal distribution of the volcanic rocks; and
- Different reciprocal stratigraphic relationships of the volcanic rocks with the different level of weathering and variable topographic position of the volcanic rocks.

Based on the hydraulic conductivity data of existing wells assessed during literature review, the various formations in the area have been classified into three groups of High (greater than 40 m/day), Moderate (1-40 m/day) and Low (less than 1 m/day) permeabilities. The aquifer of the Project area is

fractured ignimbrite covered with lacustrine sediments, classified as having Moderate permeability (hydraulic conductivity).

8.7.2 BAEKER IAIP

Groundwater use in the vicinity of the Baeker IAIP site is relatively limited, with no active groundwater abstraction/utilisation points being identified within the proposed Project boundaries. Two shallow hand dug wells were identified in the area, one of which had been dug in a stream channel. Water levels in these wells were relatively shallow, with water levels of 0 metres and 7.1 metres below surface recorded in the two wells respectively.

According to the local people, the open hand-dug well was drilled at the centre of the stream by a commercial farmer west of the Baeker IAIP to serve for cattle watering during the dry season. At the time of sampling the well it was filled with surface water, although no flowing flood water was observed at the time. The second well is an open community hand-dug well that serves for drinking water located close to the Telecom Tower, approximately 3.5, northwest of the IAIP. The identified groundwater points for the IAIP site are summarised in **Table 8-8** and are shown in **Figure 8-18** respectively.

It is noted that during the extensive site surveys around the Baeker IAIP, undertaken with the assistance of local Water Bureau officers and additional local people, it was indicated that in addition to the two hand dug wells described above, there was one deep borehole which was drilled by a Chinese highway contractor some years back when the tarmac road was under construction. The ESIA team located that deep well however it was found to be abandoned, dry and not functional.

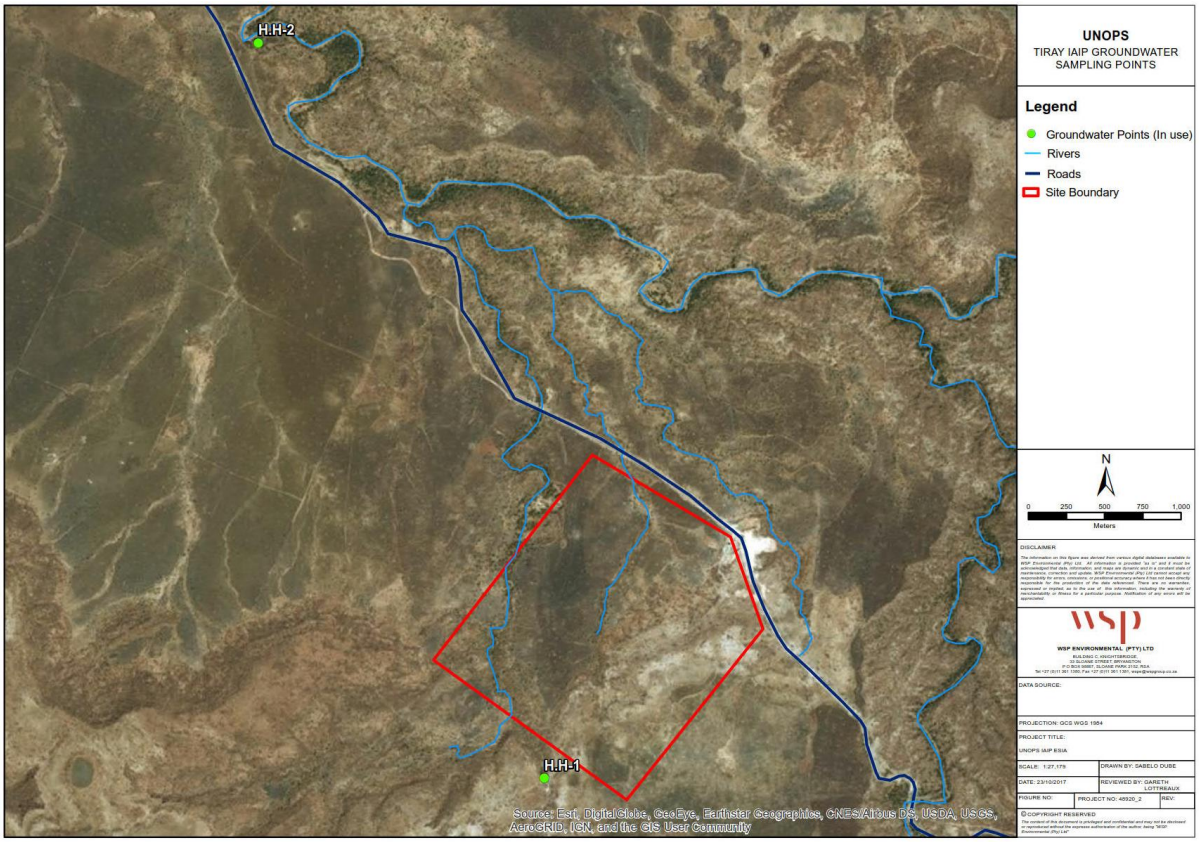

Figure 8-18: Layout showing the location of the identified well points around the IAIP site.

Table 8-8: Baeker IAIP groundwater point summary

Point	Easting	Northing	Type	Status	Static water level (mbgl)	Comments
H.H-1	259153	1551588	Hand dug well	In use	0.0	Hand dug well located in a streambed. Local community

Point	Easting	Northing	Type	Status	Static water level (mbgl)	Comments
						report that the well is used for livestock watering.
H.H-2	257379	1556398	Hand dug well	In use	7.1	Hand dug well located approximately 3.5 km north west of the IAIP site. Used for domestic water supply

8.7.3 MAI KADRA RTC

Groundwater use in the area of the RTC site is more prolific, with three deep water supply boreholes being identified, ranging in depth from 120 to 150 metres below surface level. These boreholes are used to supply the town of Mai Kadra with water for domestic purposes. Reported static water levels in these boreholes range from 57m to 97.05m below surface level. Shallow groundwater levels in the hand dug wells at the Baeker IAIP site and deeper water levels at the Mai Kadra RTC site indicate the presence of a shallow, unconfined primary aquifer, underlain by a deeper, confined or semi confined secondary aquifer.

The identified groundwater points for the RTC site are summarised in **Table 8-9** and are shown in **Figure 8-19**.

Figure 8-19: Groundwater Sampling Points for the Mai Kadra Site

Table 8-9: Mai Kadra RTC groundwater point summary

Point	Easting	Northing	Type	Status	Static water level (mbgl)	Comments
Mai Kadra E (TWWCE)	236007	1556445	Deep borehole	In use	57.00	Approx. 2km north east of the RTC site. Used as a municipal

Point	Easting	Northing	Type	Status	Static water level (mbgl)	Comments
						supply well for Mai Kadra town.
Mai Kadra G (Sur Borehole)	238036	1553894	Deep borehole	In use	97.05	Approx. 0.8km south of the RTC site. Used as a municipal supply well for Mai Kadra town.
Mai Kadra (Mesebo) Borehole	237868	1554416	Deep borehole	In use	73.20	Approx. 1.2km south of the RTC site. Used as a municipal supply well for Mai Kadra town.

GROUNDWATER QUALITY

According to the MME study (Ministry of Mines and Energy, 1996), the general groundwater quality in the area is good, with the only real contaminant of concern being faecal coliforms. The quality of water was confirmed by samples collected during the August 2017 site visit, the results of which are presented in **Table 8-10**. The complete laboratory report is attached in **Appendix C-3**.

Table 8-10 : Water Quality Results for Tigray IAIP and RTC Sites

Test	Units	Ethiopian Standard	WHO Guidelines	H.H-1	MESEBO BH
Aluminium	µg/l	200	100	<20	<20
Antimony	µg/l	-	20	<2	<2
Arsenic	µg/l	10	10	<2.5	<2.5
Barium	µg/l	700	700	93	47
Boron	µg/l	300	500	24	45
Cadmium	µg/l	3	3	<0.5	<0.5
Total Chromium	µg/l	50	50	<1.5	<1.5
Copper	µg/l	2000	2000	<7	<7
Total Iron	µg/l	300	-	<20	<20
Lead	µg/l	10	10	<5	<5
Manganese	µg/l	500	400	32	<2
Mercury	µg/l	-	6	<1	<1
Nickel	µg/l	-	70	<2	<2
Selenium	µg/l	-	10	<3	<3
Sodium	mg/l	200	40	5.2	56.2
Uranium	µg/l		15	<5	6
Zinc	µg/l	5000	3	<3	750
Fluoride	mg/l	1.5	1.5	<0.3	<0.3
Sulphate as SO_4	mg/l			5.8	17.6
Chloride	mg/l	250	-	2.7	2.1
Nitrate as N	mg/l	50	50	0.35	0.21
Nitrite as N	mg/l	3	3	0.027	<0.006

Test	Units	Ethiopian Standard	WHO Guidelines	H.H-1	MESEBO BH
Total Cyanide	mg/l	70	70	<0.01	<0.01
Electrical Conductivity	µS/cm	-		300	929
Free Ammonia as N	mg/l	1.5	1.5	<0.006	<0.006
Free/Residual Chlorine	mg/l	0.5	5	<0.02	<0.02
pH	pH units	6.5 - 8.5	6.5 - 8.5	7.77	7.48
Total Dissolved Solids	mg/l	1000	600	216	559
Turbidity	NTU	-	5	4.8	0.3

The results of the groundwater quality analysis indicate that the groundwater quality in the area is good, with only sodium and zinc values being elevated slightly above the WHO recommended guidelines. 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

A wetland desktop screening and infield assessment relating to the proposed Baeker IAIP and the associated RTC site (the 'sites') was undertaken as part of the scoping phase. This assessment was undertaken to determine whether the proposed sites may intrude into the delineated boundary of a wetland and potential significance of the impacts on the system.

8.8.1 BAEKER IAIP

The desktop screening and infield assessments of the Baeker IAIP 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. The only river/stormwater channel system on the IAIP site is an ephemeral channel crossing the western corner of the site. The major watercourse in the region is the Tekeze River which runs a significant distance to the north of the site. The Bombeia River which is approximately 4.5km from the site drains into the Tekeze River. Therefore, with limited wetland features on the site, no further functional assessments, and impact assessment or mitigation measures are required for the proposed IAIP site.

8.8.2 MAI KADRA RTC

The desktop screening and infield assessments of the Mai Kadra RTC determined that there were no wetland habitats within the site boundaries or in close proximity to the site. Therefore there is no potential for wetland habitats to been indirectly impacted. No further functional assessments, impact assessment or mitigation measures are required for the proposed RTC site.

8.9 AIR QUALITY

8.9.1 BAEKER IAIP

Potential sources of emission associated with the operational phase include:

- Light industrial and commercial activities; and
- Vehicle tailpipe emissions.

Table 8-11 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 being the main source of particulate and gaseous emissions. The boiler will also generate emissions during start-up, normal and abnormal operating conditions. The brewery and meat rendering will likely be a key source of odorous emissions. 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 8-11: List of various IAIP units and associated air quality sources

Unit	Potential Air Quality Sources	Pollutants
Sewage treatment plant	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
Controlled atmospheric storage	-	-
Brewery	Wort boiling	Odour
	Use and storage of grains, sugar and kieselguhr	TSP, PM_{10}, $PM_{2,5}$
	Trucks	TSP, PM_{10}, $PM_{2,5}$, SO_2, NO_2, CO, VOCs
Cereals processing unit	Trucks	TSP, PM_{10}, $PM_{2,5}$, SO_2, NO_2, CO, VOCs
Cereals anchor units	-	-
Cereals raw material storage	-	-
Fruit and vegetable processing unit	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
Sesame processing unit	-	-
Sesame raw material storage	-	-
Sesame anchor unit	-	-
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

Unit	Potential Air Quality Sources	Pollutants
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	-	-
Certification lab	-	-
Retail space	-	-
Polyclinic	-	-
Substation	-	-
Extension centre	-	-
Administrative building	-	-
Training centre	-	-

To assess the current baseline ambient air quality situation at the Beaker IAIP site, dust fallout is being conducted at four points at the IAIP site. These dust fallout (DFO) stations were installed on the 20 September 2017 and the monitoring was conducted to the 15 November 2017. The DFO monitoring points are identified in **Table 8-12** and shown on **Figure 8-20.** Passive monitoring of SO_2 and NO_2 concentrations was also undertaken at the same sites for a 14 day period from 20 September 2017 to 4 October 2017.

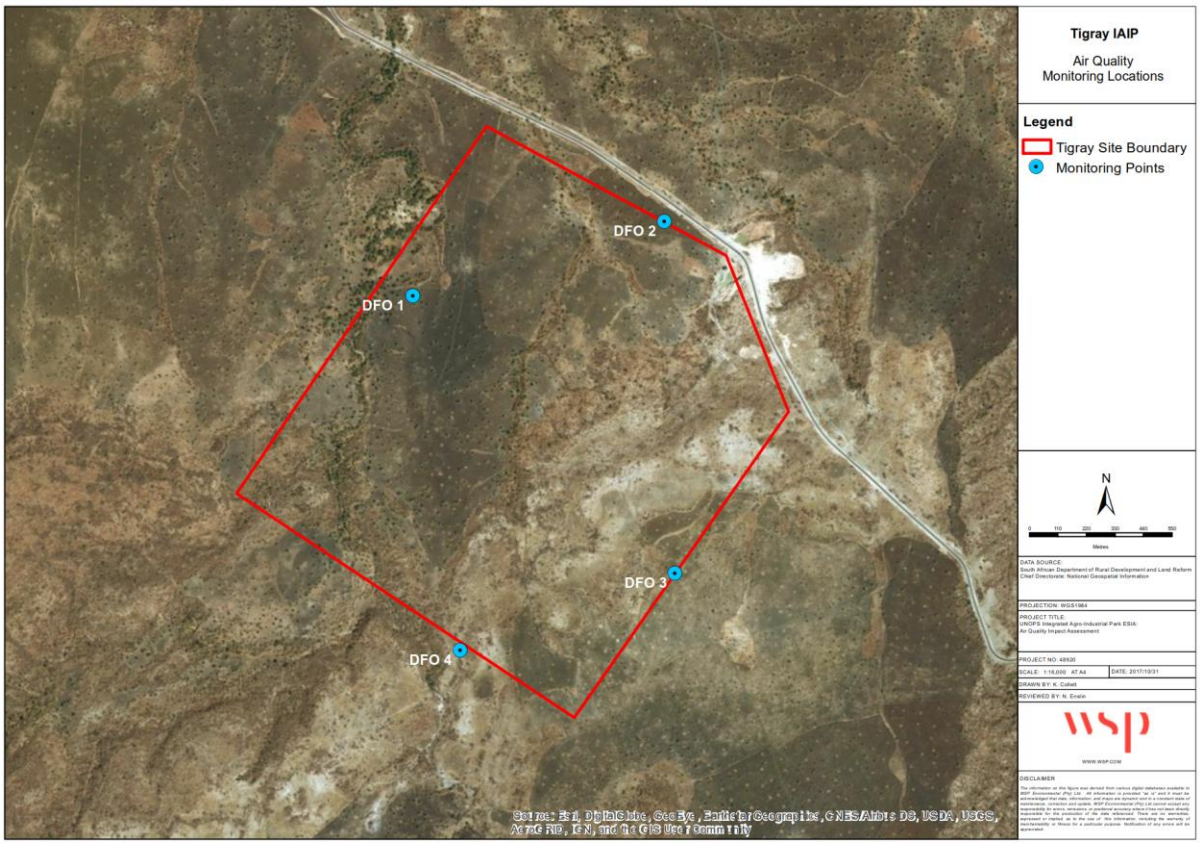

Figure 8-20: Dust fallout and passive monitoring locations at Tigray Baeker IAIP.

Table 8-12: Coordinates of dust fallout and passive monitoring locations at Baeker IAIP.

Sampling Point	Coordinates	
	Easting UTM N (m)	Northing UTM E (m)
DFO 1	1553066.15	259169.17
DFO 2	1553290.70	260134.73
DFO 3	1551959.86	260095.24
DFO 4	1551718.62	259267.51

As per the terms of reference, DFO monitoring was proposed to be undertaken for a three-month period. However, due to constraints experienced, including 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.

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 8-21** 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).

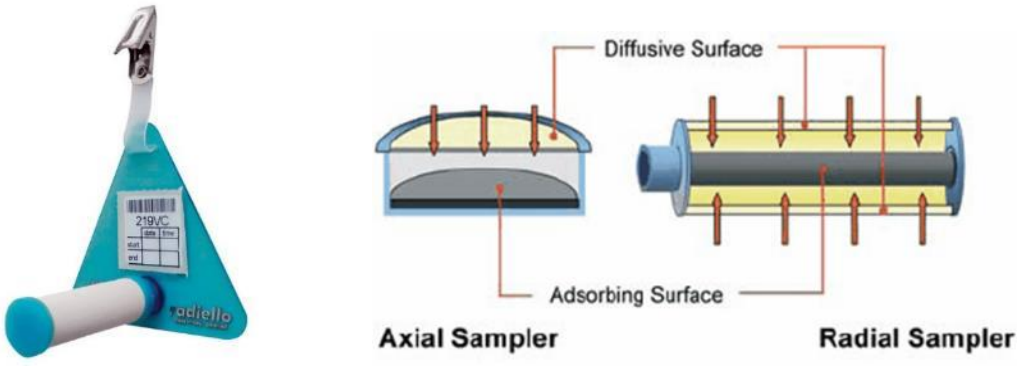

Figure 8-21: Diffusive and absorbing surfaces of a passive sampler

SITE ASSESSMENT RESULTS

No monitoring data is available to date to assess the baseline air quality situation. This information will be utilised in the impact assessment phase to assess the potential impacts the proposed Project may have on the surrounding receptors.

SENSITIVE RECEPTORS

The nearest town of Baeker is located approximately 9 km to the southeast of the Baeker IAIP site. Sensitive receptors located in close proximity to the RTC site include the southern section of Mai Kadra town. **Table 8-13** identifies receptors surrounding the IAIP and RTC sites and the direction and distance from the sites.

Table 8-13: Sensitive receptors surrounding the Tigray Baeker IAIP and RTC

Site	Receptor	Distance	Direction
Baeker IAIP	Baeker	~ 9 km	Southeast
	Humera	~ 30 km	North northwest
Mai Kadra RTC	Mai Kadra	~ 1 km	North

8.9.2 MAI KADRA RTC

The Mai Kadra site is surrounded by agricultural land (predominantly crops) with low to medium density residential areas and light industrial activity. No major sources of air quality emissions are anticipated to result from the site. It is anticipated that air quality impacts resulting from the RTC activities will be negligible and as such an air quality scoping assessment of the RTC site was not conducted.

8.10 CLIMATE CHANGE

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 percent 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 gross domestic product (GDP) up to 10 percent 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.

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 percent to +30 percent by the 2050s; and
- Increases in the proportion of total rainfall that falls in “heavy” events with annual increases of up to 18 percent.

Figure 8-22 shows the climate classification in Ethiopia.

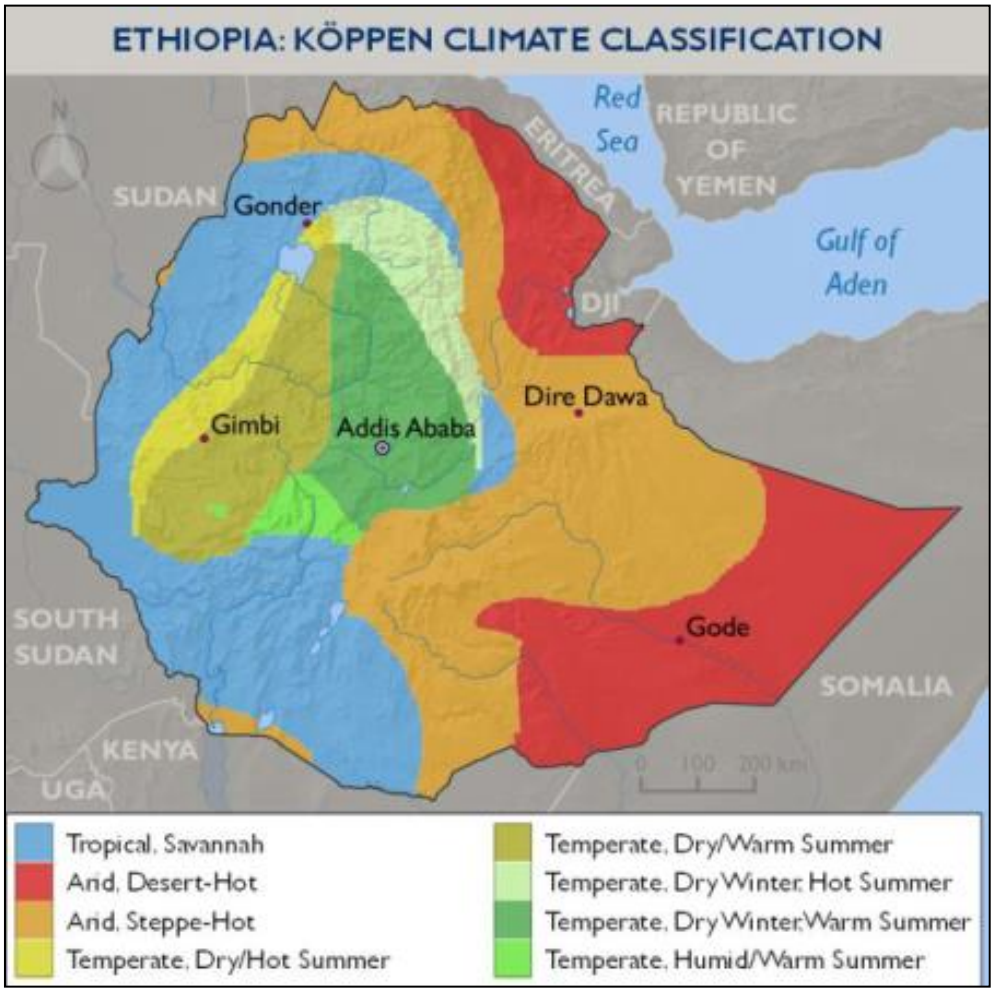

Figure 8-22 : Climate classification in Ethiopia (Climate Risk Profile: Ethiopia)

8.11 NOISE

8.11.1 BAEKER IAIP

The current noise climate is typically rural, with very limited anthropogenic influences. The site currently consists of farming activities which do not generate significant levels of noise. The only identifiable source of noise is the highway, which connects Gondar and Humera, which borders the site on its northern boundary.

NOISE MONITORING METHODOLOGY

In order to assess the current noise climate in the vicinity of the Baeker IAIP, ambient environmental acoustic monitoring was undertaken on 14 August 2017 at four locations in and around the proposed site (**Table 8-14** and **Figure 8-23).**

Table 8-14: Noise monitoring locations.

ID	Classification	Coordinates	
		Easting UTM N (m)	Northing UTM E (m)
T_01	Residential	259334.48	1553451.20
T_02	Residential	260122.53	1553280.96
T_03	Residential	260090.25	1551950.57
T_04	Residential	259447.04	1551580.32

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.

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.

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.

Figure 8-23: Noise monitoring locations surrounding the Tigray Baeker IAIP.

The make and model as well as serial number and calibration validity of the sound level meter and calibrator are presented in **Table 8-15.**

Table 8-15: 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
Calibration due date: November 2017	Calibration due date: November 2017

DAY-TIME MONITORING RESULTS

The results from the day-time noise monitoring campaign conducted on 14 August 2017 are presented in **Table 8-16** and **Figure 8-24**. Noise levels were compared to the typical day-time guideline level for noise in residential areas (55 dB(A)). Noise levels at three of the four monitoring locations were well below the guideline level. The highest noise levels were recorded at T_01, T_02 and T_03, which are in closest proximity to the nearby highway. Road traffic (although very limited) was the dominant noise source at all three locations. Considerably lower noise levels were recorded at T_04, which is located the furthest distance from the highway.

Table 8-16: Day-time noise monitoring results.

Location	Time	L_{Aeq} (dB(A))	L_{Amax} (dB(A))	L_{Amin} (dB(A))	WHO Guideline (dB(A))	Compliant
T_01	13:12	39.5	61.9	22.1	55	**Yes**
T_02	13:38	41.6	62.5	24.3	55	**Yes**
T_03	14:43	44.1	61.1	24.8	55	**Yes**
T_04	14:17	33.9	54.7	21.3	55	**Yes**

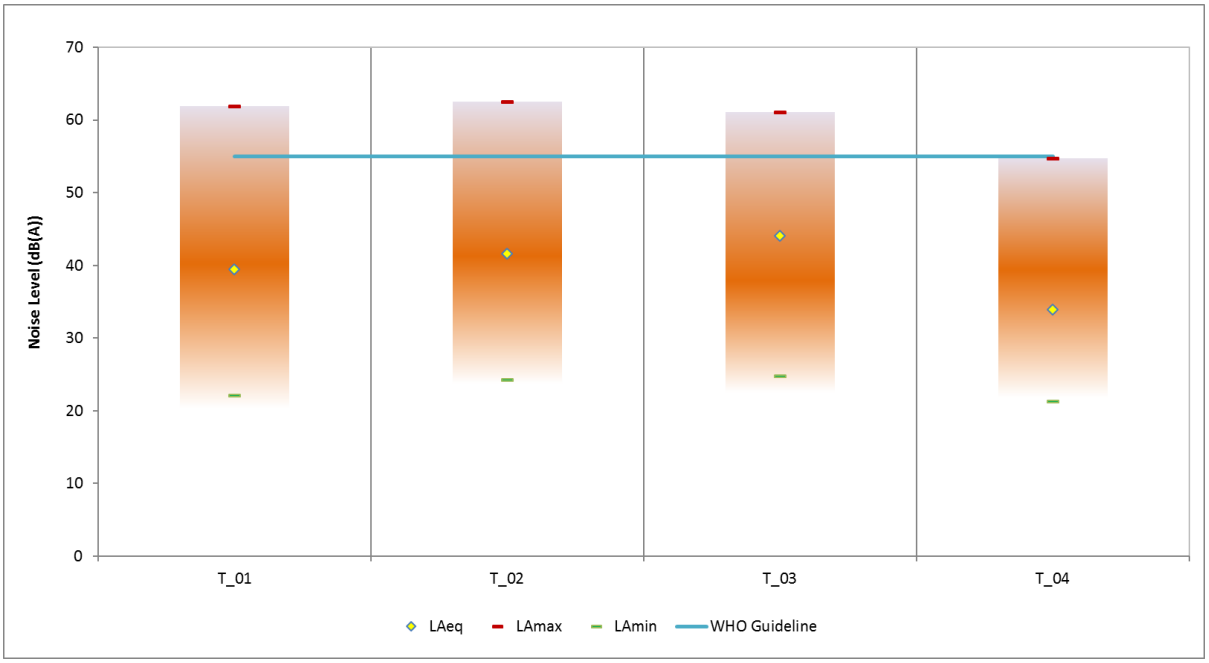

Figure 8-24: Day-time monitored noise levels. LAeq (yellow diamond) compared with the WHO guideline.

NIGHT-TIME MONITORING RESULTS

The results from the night-time noise monitoring campaign conducted on 14 August 2017 are presented in **Table 8-17** and **Figure 8-25**. Noise levels were compared to the typical night-time guideline level for noise in residential areas (45 dB(A)). Noise levels at all four monitoring locations were below the guideline level. Noise levels at T_01 and T_05 (both located alongside the federal highway) exceeded the guideline level. The highest noise levels were recorded at T_02, located on the northern boundary of the proposed site, alongside the highway. The main source of noise at this location was traffic operating on the highway.

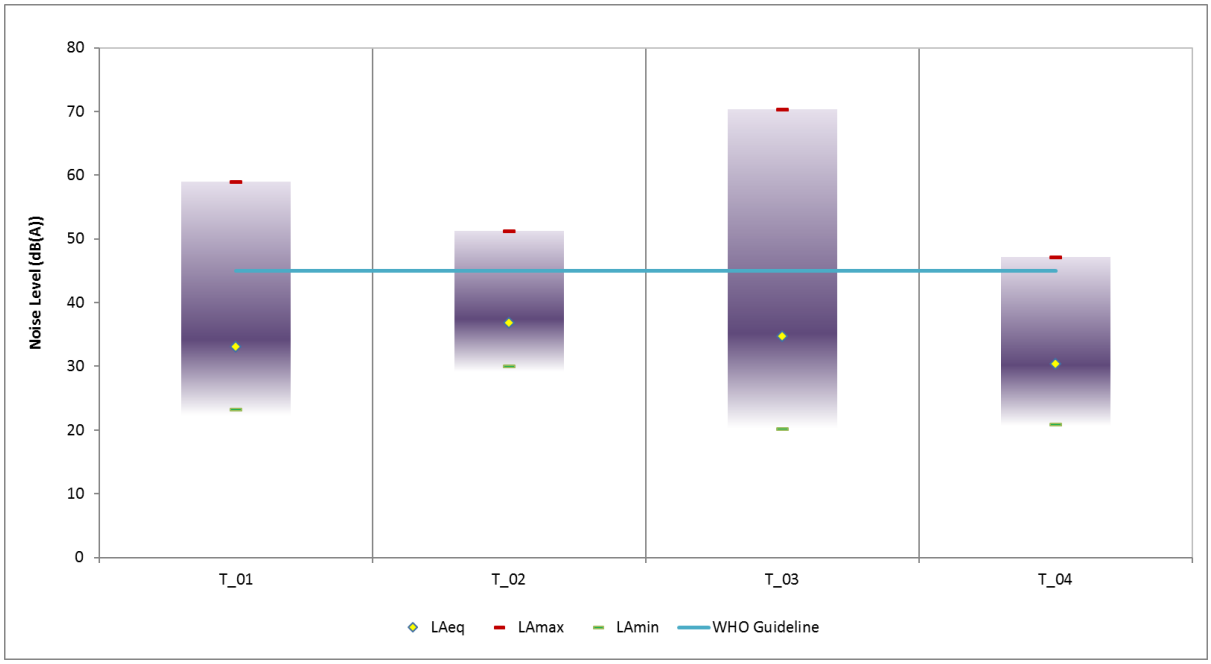

Figure 8-25: Night-time monitored noise levels. LAeq (yellow diamond) compared with the WHO guideline.

Table 8-17: Night-time noise monitoring results.

Location	Time	L_{Aeq} (dB(A))	L_{Amax} (dB(A))	L_{Amin} (dB(A))	WHO Guideline (dB(A))	Compliant
T_01	22:00	33.1	59.0	23.2	45	Yes
T_02	22:25	36.9	51.2	30.1	45	Yes
T_03	22:58	34.7	70.4	20.2	45	Yes
T_04	23:26	30.4	47.2	20.9	45	Yes

8.11.2 CONSTRUCTION PHASE ASSESSMENT

Detailed construction plans 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 8-18** 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 8-18: 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**

8.11.3 OPERATIONAL PHASE ASSESSMENT

A high-level, semi-quantitative assessment of the potential sources and impacts associated with the IAIP site has been undertaken. This assessment is based on the current master plan for the site. 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 8-19** 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 8-19: List of various IAIP units and associated significant noise sources

Unit	Potential Significant Noise Sources	Sound Power Level (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
	Compressor	102.0
Milk & Dairy Plant	Trucks	85.0
	Homogenizer	82.0
	Centrifuges	73.0
	Filling and packing machinery	90.0
Honey processing unit	-	-
Controlled atmospheric storage	-	-
Brewery	Trucks	85.0

Unit	Potential Significant Noise Sources	Sound Power Level (dB(A)
	Process and utility machinery	96.0
Cereals processing unit	-	-
Cereals anchor units	-	-
Cereal raw material storage		
Fruit and vegetable processing unit	-	-
Sesame processing unit	-	-
Sesame raw material storage	-	-
Sesame anchor unit	-	-
Poultry - egg processing unit	Compressor	102
Poultry - egg storage unit	-	-
Other animal products processing unit	-	-
Meat - deep freeze cold storage	Compressor	102
Meat anchor unit	-	-
Meat processing unit	Fans	98.0
	Rotary Saws	100.0
	Compressor	102.0
	Pumps	104.0
Meat rendering unit	-	-
Finished goods storage		
Grading, packing and labelling		
School	-	-
Crèche	-	-
Playground	-	-
Certification lab	-	-
Retail space	-	-
Polyclinic	-	-
Substation	-	-
Extension centre	-	-
Administrative building	-	-
Training centre	-	-

8.11.4 MAI KADRA RTC

The Mai Kadra site is surrounded by agricultural land (predominantly crops) with low to medium density residential areas. Based on the location of the site, the volume of vehicles utilising the road are not anticipated to be significant. Additionally no major industrial activities have been reported to be operational in close proximity to the site. As such, no major sources of noise are anticipated in close proximity to the site.

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

8.12 TRANSPORT / ACCESS

8.12.1 BAEKER IAIP

ROAD NETWORK

The local road network consists of the road which connects Gondar, 220 km to the south-east of the IAIP, to Humera, 33km to the north-west of the IAIP on the Eritrean border. The road is a single carriageway surfaced road, with one lane per direction (see **Figure 8-26**).

The road is suitable to provide vehicle access and connectivity to the development, pending the provision of suitable local accesses that takes cognisance of vehicle and non-motorised transport (NMT) safety.

TRAFFIC VOLUMES AND SAFETY

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.

ROAD NETWORK AND MASTER PLANNING

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

Figure 8-26: Photograph of the road adjacent to the Baeker IAIP connecting Gondar and Humera.

8.12.2 MAI KADRA RTC

ROAD NETWORK DESCRIPTION

The local road network consists of the surfaced road to Mai Kadra, located directly adjacent to the site. The road is a single carriageway surfaced road, with one lane per direction (see **Figure 8-27**). The road is suitable to provide vehicle access and connectivity to the development, pending the provision of suitable local access that takes cognisance of vehicle and non-motorised transport (NMT) safety.

Figure 8-27: Photograph of the local road adjacent to the Mai Kadra RTC site

TRAFFIC VOLUMES AND SAFETY

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

ROAD NETWORK AND MASTER PLANNING

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

8.13 VISUAL

8.13.1 BAEKER IAIP

The site is located in a rural area surrounded by commercial agricultural land and mixed vegetation. The vegetation of the area is largely shrubs and the dominant land use of the area is open shrubs and cultivated land. The dominant agricultural system is mixed farming, where farmers are engaged in crop and animal production. The major crops grown in the area are sesame and sorghum.

The structures located on the site are temporary in nature and have been established on the site for the purpose of providing temporary dwellings / camp for contract labourers during the harvest season associated with the highly seasonal farming activities in the area. Large areas of the site consist of cultivated farmland, with sections of the site consisting of mixed vegetation, mostly where the ground is not suitable for tilling. Agricultural land and mixed vegetation surround the site.

LANDSCAPE CHARACTER

The Project area is characterised by vast flat land with scattered hills of volcanic origin. The site is bordered by hilly escarpments in the north-northeast direction (see **Figure 8-28**). The site comprises fairly even land with various portions where large erosion gulleys are evident. The visibility of the site is limited to the road which passes along the north eastern boundary of the site. The variable topography, and drainage lines, limit the visibility of the site from the road. This is especially evident when approaching the site form the east as the site is obscured from view by a hilly outcrop. There is evidence of quarrying activities having taken place within the outcrop area, likely for material used during the construction of the federal highway running adjacent to the IAIP site.

The land has been transformed by agricultural activities, therefore natural vegetation remains in areas which are unfavourable to farming activities. Open areas have been cleared of natural vegetation to facilitate agricultural activities, mainly in the form of crop plantations.

Figure 8-28: Photographs showing typical landscape character of the Baeker IAIP Site (Source: ESIA team site investigation)

Visually the site supports open cropland with remnants of forest vegetation along the drainage channels and scattered patches of tree species concentrated to the south west of the IAIP.

The road which abuts the site has very low usage with the primary users being local farmers and commuters from Humera to the airport and vice versa. The road has higher usage by commuters when flights arrive or depart from the local airport located approximately 30km southeast of the IAIP site.

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 but only from an elevated position; 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:

- **Motorists:** The IAIP site may be visible to motorists who are travelling between Baeker and Mai Kadra. However visibility of the site is limited by the hilly outcrop on the northeastern portion of the site corner of the site limiting visibility of the site to motorists travelling from Baeker to Mai Kadra. The site is more visible to motorists travelling easterly form Mai Kadra toward Baeker due to the flat topography of the land from this direction.
- **Adjacent site users:** Land surrounding the site consist predominantly of commercial agricultural activities. It is anticipated that these activities will continue following the development of the IAIP, hence users of these sites will have clear visibility of the IAIP.

8.13.2 MAI KADRA RTC

The RTC site has been totally transformed by agricultural activities in the form of crop production (see **Figure 8-29**). There is a general decrease in slope westwards towards the road abutting the site. Given the sites location, adjacent to an urban area, the sensitivity of the viewers or possible receptors to an industrial development will be less as this is in context with land uses in close proximity to the site. A boundary wall is partially constructed around the site. Once complete the wall will limit visibility of the internal activities of the RTC due to the relatively flat topography of the site.

Figure 8-29: Images showing Tigray Mai Kadra RTC Site (Source: ESIA team site investigation)

8.14 WASTE MANAGEMENT

8.14.1 TIGRAY BAEKER IAIP

CURRENT WASTE MANAGEMENT OF TIGRAY BAEKER TOWN

SOLID WASTE MANAGEMENT

Generation, Collection and Transportation

In 2015/16 the Tigray Regional State Sanitation and Beautification Bureau prepared estimations of daily solid waste generation for the towns in the region which is applied for solid waste planning

purposes. According to these estimations the daily waste generation of Baeker Town is estimated to be 4254.5kg or 12.78 m^3 per day. The average per capita solid waste generation rate per individual for town residents in the region is estimated to be 0.39kg/day.

Baeker Town does not have a formalised solid waste collection and transport system. According to Baeker Town Sanitation and beautification office, there are five employees responsible for street cleaning and solid waste collection. Waste collection and transport in the town is supported by two horse drawn carts. There are no containers for collection, skip trucks for transport and designated landfill for disposal. The two waste collection and transport horse carts provide its services to manage street cleaning wastes and to collect waste from commercial establishments in the town. Household residents are largely responsible for the collection and disposal of their own waste by their own means. Accordingly, some residents take their organic wastes to their farms with the help of tractors to apply it as compost fertilizer. Other residents convey their solid waste to the informal dumpsite by their own means.

Waste Disposal

Baeker Town has no well-designed and controlled landfill site. There is a landfill site located to the south of Baeker Town. This landfill has three unlined pits and is located on flat farmland and has been developed to convert municipal waste to compost (Situation Analyses Final Report of Baeker Town, 2012). This landfill is not suitably serviced with no water supply, lighting or collection and transportation facilities. Solid waste is collected in the dump site and recovery of some organic and inorganic waste is done from the dump site.

It is common to see wastes discarded everywhere in streams, drainage lines, on open spaces, farm lands, gullies and gorges. This is because of the inefficient collection system (frequency and accessibility), lack of awareness of inhabitants on sanitation and related impacts, and weak environmental management system.

Associated Solid Waste Management Plan

Solid waste management is generally one of the municipal functions of urban administrations. Baeker Town is in the process of establishing and strengthening its municipality. As a consequence, the town does not have a consolidated waste management plan currently. According to the town sanitation and beautification office, the immediate plans in the area of waste management for the current fiscal year (2017/18) is to select a suitable landfill site for disposing waste and to fence it.

LIQUID WASTE MANAGEMENT

As it is the situation in most towns and cities of Ethiopia excluding Addis Ababa, there is no sewerage infrastructure in Baeker Town that collects and conveys sewage from each household to a waste water treatment plant. Generally, liquid waste is collected from septic tanks by vacuum truck and disposed in a suitable place. Since Baeker town municipality do not own and provide vacuum truck service to the residents, such services are hired by the residents themselves from other nearby towns such as Humera.

8.14.2 MAI KADRA RTC

The Mia Kadra RTC is located at the southern outskirts of Mai Kadra town, approximately 1.1km distance from the town centre. Mai Kadra town is one of the big towns found in the Kafta Humera Woreda and is administered by urban administration headed by a Mayor. The town hosts a large population especially labourers migrating from the Ethiopian highlands for seasonal farm work.

CURRENT WASTE MANAGEMENT OF TIGRAY MAI KADRA TOWN

SOLID WASTE MANAGEMENT

Generation, Collection and Transportation

The solid waste generation estimates of Mai Kadra town was also one of those covered by the study conducted in 2015/16 by the Tigray Regional State Sanitation and Beautification Bureau. According to these estimations the daily waste generation of Mai Kadra is estimated to be 10828.35kg or 32.58 m^3 per day. Mai Kadra town appears to generate more solid waste than Baeker town owing to its larger population size. The average per capita solid waste generation rate per individual for town residents in the region is estimated to be 0.39kg/day.

Mai Kadra town does not have a well organised solid waste collection and transport system. However, the town appears to be making efforts to formalise its solid waste management system with the available resources. Street cleaning and solid waste collection in Mai Kadra is carried out by one small and micro enterprise (SME). The SME has 10 members that work on street cleaning and door to door waste collection. The collection and transport of solid waste is assisted by a municipality tractor which provides door to door collection service once a week. According to Mai Kadra Sanitation and beautification office, the door to door waste collection scheme carried once a week is getting overwhelmed as the quantity of waste that needs to be collected from the town residents is increasing.

Waste Disposal

Mai Kadra town has a designated and controlled landfill site. The designated landfill site is situated in the south western parts of the town at a distance of approximately 1.5km from the town. The landfill was initially fenced by the municipality, but the fencing material was looted and now remains unfenced. The road leading to the landfill is not well paved and the landfill lacks infrastructure.

Associated Solid Waste Management Plan

The current solid waste management plans of Mai Kadra town indicates that there is a plan to collect and dispose 10,000 m^3 of solid waste during the 2017/18 fiscal year. Because of current budget shortages within the Mai Kadra municipality, there are no plans to expand the solid waste management services by providing additional facilities to the collection and transport system. According to the town Sanitation and beautification office, if the revenue of the town improves and additional budget is allocated, the priority will be to undertake maintenance of the fence and road of the landfill site.

LIQUID WASTE MANAGEMENT

Municipal solid and liquid waste collected from Mai Kadra is transported to the landfill with the help of the tractor and disposed there. According to the town Sanitation and beautification office, a total of 9671 m^3 of solid waste was transported and disposed at the landfill during the 2016/2017 Ethiopian fiscal year. The town also disposes of liquid waste collected by vacuum trucks in a separate pit holes prepared for sewage disposal. Waste segregation is also done at the landfill. Organic wastes are separated from non-organic wastes especially plastic materials of bottled water containers. Composting of the organic waste is also carried at the landfill. It is worthy to note that, though it is designated and controlled disposal site, the landfill is not appropriately designed, constructed and operated as a sanitary landfill site.

8.15 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 surveys and consultations with concerned authorities.

8.15.1 BAEKER IAIP SITE

FLORA

The area is mainly represented by a *Combretum-Terminalia* ecosystem and also other fragmented vegetation types such as *Acacia spps*., and riverine type vegetation. The *Combretum-Terminalia* ecosystem is characterised by *Combretum spp., and Terminalia spp.,* such as*: Oxytenanthera abyssinica, Boswellia papyrifera, Anogeissus lieocarpa, Sterospermem kuntianum, Lonchocarpus laxiflorus, Albizia malacophylla, Termminallia brownie, Combretum molle,* and *Combretum aculeatum.* These are small trees with fairly large deciduous leaves, which often occur with the lowland bamboo-*Oxytenanthera abyssinica.* The understory is a combination of herbs and grasses.

The majority of the proposed project area has been transformed for agricultural land use, hence only some remnant vegetation remains in the southwest part of the proposed project site where streams and the seasonal Semina River passes through the site. Scattered patches of tree species are found

in some parts of the proposed project site (**Figure 8-30**). No wetland was recorded and the site is dominated by dryland, weedy vegetation.

Figure 8-30: Photos showing typical remnant natural vegetation around the Baeker IAIP site.

Based on the preliminary survey conducted, a total of 21 species of plants have been recorded (**Table 8-20**).

Table 8-20: Checklists of common plant species recorded at Tigray Baeker IAIP

No.	Species Scientific Name	Local Name	Remark (relative occurrence in and vicinity of the project area)
1	*Sterculiaceae africana*	Darle (ዳርለ)	Moderate
2	*Ziziphus mauritiana*	Geba (ገባ)	Moderate
3	*Adansonia digitata*	Dima (ዲማ)	Rare
4	*Acacia seyal*	Qeyih Cheaa (ቀይሕ ጨዓ)	Dominant
5	*Acacia senegal*	Qentib (ቀንጢብ)	Dominant
6	*Boswellia papyrifera*	Meqer (መቀር)	Rare (locally threatened species)
7	*Balanites aegyptiaca*	Meqee (መቂዕ)	Dominant
8	*Acacia oerfora*	Kittirit (ክትሪት)	Less dominant
9	*Ziziphus spina-christi*	Gaba (ጋባ)	Dominant
10	*Combretum molle*	Sessewe (ሰሰወ)	Moderate
11	*Acacia polycantha*	Gomoro ()ጎሞሮ	Moderate
12	*Dichrostachys cinerea*	Gonoq (ጎኖቅ)	Dominant
13	*Combretum collinum*	Tenkelba (ጠንቀለባ)	Moderate
14	*Anigeissus leiocarpus*	Hanse (ሓንሰ)	Less dominant
15	*Dalbergia melanoxylon*	Zibe (ዝበ)	Less dominant
16	*Termminallia brownie*	Weyiba (ወይባ)	Dominant
17	*Commiphora africana*	Hanse (ሓንሰ)	Less dominant
18	*Oxythenthera abssinica*	Qola Ariqay (ቆላ ኣርቃይ)	Endangered species
19	*Carissa spinarum*	Agam (ዓጋም)	Less dominant
20	*Syzigium guineense*	Dokima (ዶቕማ)	Less dominant
21	*Combretum aculeatum*	Sebaa (ሰበዓ)	Moderate

FAUNA

Limited avifauna was encountered on the site, a list of the common bird species expected to be present at the project site are presented in Table 8-21 below. Mammals considered common for the site area are presented within Table 8-22 below.

Table 8-21: List of Common Bird Species of the Project Site

No	Species Common Name	Scientific Name	Remark
1	Red-billed hornbill	*Tockus erythrorhynchus*	Common
2	Helmeted Guinea fowl	*Numida meleagris*	Common
3	Yellow-billed hornbill	*Tockus flavirostris*	Rare
4	African mourning dove	*Streptopelia decipiens*	Common
5	Greater blue-earned starling	*Lamprotornis chalybeus*	Common
6	Little Egret	*Egretta garzetta*	Common

Table 8-22 List of Common Mammal Species of the Project Site

No	Species Common Name	Amharic Name	Scientific Name	Remark
1	Olive Baboon	Tiqur Zinjero	*Papio anubis*	Rare
2	Spotted Hyena	Tera Jib	*Curocula curocula*	Common
3	Abyssinian Hare	Tinchel	*Lepus habesinicus*	Common
4	Common Bushbuck	Tera Dicula	*Traglaphus scriptus*	Rare
5	Common warthog	Kerkero	*Phacochoerus africanus*	Rare

8.15.2 PROTECTED AND NON PROTECTED SITES IN THE AREA

PROTECTED AREAS

Based on the desktop review, field survey and consultation with stakeholders it was confirmed that there are no protected biodiversity sites within a 10km radius of the proposed project site. The only sensitive habitats include the watercourses that pass through the propose project site. There are no IUCN red list fauna and flora species found in the propose project site.

WETLANDS

No wetlands were recorded around the Baeker IAIP site.

8.15.3 MAI KADRA RTC

The Mai Kadra, RTC, site has been entirely transformed to agricultural land use with no natural vegetation (except weeds and some sages) remaining on the site and within the vicinity of the project area. The site is in very close proximity to the urban area (town) and therefore the presence of birds and mammals is limited.

8.16 SOCIO-ECONOMIC ENVIRONMENT

8.16.1 GENERAL

The purpose of this section is to describe the socio-economic environment within which the Project is located. The description provided in this section is based on publically available, high level secondary and primary data, including the 2007 National Census data which in most cases was extrapolated by the regional governments to reflect the estimated population growth, and so forth. A full and more current account of the Project Site and area will be provided in the ESIA drawing on primary data collected for this site.

The proposed Baeker IAIP site is located within the wider footprint of the Baeker town and is 25km away from the Humera Town, the capital of the West Tigray Zone. Humera town is approximately 975km from Addis Ababa. Baeker Town is found within Kafta Humera and receives political and administrative leadership from the executive body of this Woreda. Baeker Town has strong economic and social ties with the people living in Welkait, Tsegeda and Tahitay Adiabo Woredas.

The IAIP footprint in the West Tigray Zone will occupy approximately 258.62 hectares. The land planned for the IAIP development was previously predominantly state-owned but used by local farmers for agricultural activities. After this project was taken forward during 2014-2016 the Government initiated the resettlement process and to-date completed a census of the affected people and a list of the affected assets and their compensation (2017).

Thirty-one (31) PAPs were identified as those whose land will be fully or partially affected by the development of the Baeker development and nine (9) PAPs will be affected by the Mai Kadra RTC development.

Further details on the Government-led resettlement process are provided in the Tigray RAP report.

- The area likely to be affected by the proposed Project activities during the pre-construction, construction operations and closure / decommissioning phases;
- The IAIP site area from where the affected households will be relocated by the local Government authorities;
- The area occupied by the IAIP for auxiliary infrastructure associated with construction / operation activities, including the proposed access road to the site and construction camp location (if not located within the confines of the site boundaries), and;
- The area of social impacts will also include the new locations where the affected households have been moved to.

8.16.2 BASELINE ENVIRONMENT – BAEKER IAIP

DEMOGRAPHICS

Ethiopia experiences significant cross-border immigration from surrounding countries including farmers in search of grazing grounds and water, traders and merchants as well as frequent and significant influx from Somalia, Sudan, and Eritrea caused by conflict and drought. According to the United Nations High Commissioner for Refugees (UNHCR), Ethiopia received a substantial number of new immigrants in late 2014 (particularly from South Sudan), leading to a total population of more than 729,000 immigrants in early 2015, who are mainly accommodated in camps throughout the country (UNHCR, 2017).

The population in the Tigray region exceeds 5 million people, while the Kafta Humera Woreda has 92,167 people (Census 2007 data) where over 67% of the total Woreda population live in rural areas. The total Woreda population is split between 48% of women and 52% of men. In the Woreda rural areas, nearly 30% of the population is represented by children of 0-14 years of age, while the demographic group of 15-34 year olds makes 25% of the Woreda rural population. Hence, 55% of the

rural population of the Kafta Humera Woreda is made by children and young people up to 34 years of age. In the region, 5.3% of the adult population is a widow or a widower.

With an area of 4,542.33 square kilometers, Kafta Humera has a population density of 20.29, which is less than the Zone average of 28.94 persons per square kilometer; 30,234 or 32.80% are urban inhabitants. A total of 23,449 households were counted in this Woreda, resulting in an average of 3.93 persons to a household, and 22,259 housing units.

Based on the Census 2007 data, 1.6% of the region's population is disabled or suffers from a serious disease, which matches the Woreda disability level. The top three disability types at the Woreda level (among both genders) are: blindness or difficulties with seeing (24%), non-functioning lower limbs (19%) and deafness or hearing difficulties (15%). At the regional level, 10% of all children between 0-18 years of age are orphans (one or both parents are dead), while at the Woreda level this number is higher and orphans make nearly 12% of all 0-18 year old children in the Kafta Humera Woreda. Only 54% of the 5-35 year olds in the Tigray Region are literate, and the literacy levels are dropping among older population, where only 27% of 36-60 year olds in the region are literate. The literacy levels are even lower at the Zone level, where only 41% of the 5-35 year olds and 23% of the 36-60 year olds are literate. In other words, more than half of young people in the Western Zone are illiterate and three quarters of the older generation are illiterate at the Zone level. Over 35% of working age people in the Region are looking for jobs or economically inactive.

It is interesting that the 35-55 year olds which are typically the highest earning demographic group reaching their maximum earning potential, make only 9.4% of the total rural population of Woreda.

ETHNICITY, RELIGION AND LANGUAGES

Two largest ethnic groups reported in West Tigray Zone were the Tigray (92.28%), and Amhara (6.48%); all other ethnic groups made up 1.24% of the population. Tigrinya is spoken as a first language by 87%, and Amharic by 12.18%; the remaining people spoke other languages.

Over 90% of the Tigray Region population belongs to the Ethiopian Orthodox church, while the remaining 10% of the region's population are Protestants, Catholics, Islamists and traditional value believers. At the Woreda level, the number of Ethiopian Orthodox believers is a bit higher and reaches 95% of the total Woreda population.

WOMEN AND LAND OWNERSHIP

The access to resources of the households has affected the control over produce of women's land. Higher percentages of female headed households go for sharecropping compared with male headed households, because women for a number of reasons cannot always cultivate the land themselves. As such, they often can find themselves in a tricky scenario when the land is not cultivated as sharecroppers get sick, thus depriving the woman-land owner of income. As a result, women-led households often rely on community help and the lack of resources makes them likely to be food insecure or trapped in poverty.

At the same time, women in Tigray know the constitutional rights, e.g. that they have to get their share of land during a divorce. In practice, however, women could experience problems in claiming their land due to lack of legal court system, lack of clear documentation and lack of financial ability of the women to get a lawyer. Lack of independent certificates to the land determines the women control right to the land. Women in female headed households have an independent certificate to the land but not most women in male headed households.

EDUCATION

Education plays a crucial role in the process of social and economic transformation and stands as a key poverty reduction. 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 made also various efforts for the developments of education in the region to this end, general project Woredas are no exception.

There is a primary school (grade 1-8) and secondary school (grades 9-10) in Baeker. The primary school caters for 133 children and has 4 primary teachers, while the secondary school has over 250 pupils looked after by 5 teachers. Based on the Census data, 19.28% of the Kafta Humera woreda

population were considered literate, which is greater than the Zone average of 9.01%. Over 25% of children aged 7–12 in woreda were in primary school, which is greater than the Zone average of 11%.

However, based on the Demographic and Health Survey in Ethiopia carried by Unicef in 2014, only 15% of surveyed females in Tigray received education after primary school, while 85% of surveyed females received either some primary education or no primary education. For surveyed males under the same Unicef survey, 20% of surveyed males completed primary education and received post-primary education, while around 80% of surveyed males received either some or no primary education.

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 levels in Ethiopian Birr are <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.

SOCIAL INFRASTRUCTURE AND SERVICES

According to a 24 May 2004 World Bank Regional Characterisation Report in Ethiopia, 6% of the inhabitants of the Zone have access to electricity, and this zone has a road density of 23.3 kilometres per 1000 square kilometres. Rural households have an average of 1 hectare of land (compared to the national average of 1.01 and a regional average of 0.51) and an average 1.3 head of livestock.

Of all eligible children, 55% are enrolled in primary school, and 16% in secondary schools. 100% of the zone is exposed to malaria.

The Tigray region coverage in water supply stands at 73%. In spite of the regional government and development partners' efforts, groundwater levels are declining, contributing to the interruption of many shallow water supply schemes. This is also associated with the persistent droughts that occur throughout the region. Several community water points have also suffered from the declining water levels, forcing women and children to spend more time each day fetching water from far water sources. Usually, the water collected is insufficient in terms of quantity and quality, thereby leading to the transmission of water borne diseases.

The major source of potable water for the region is mainly from groundwater resource:

- Hand dug well construction;
- Shallow well drilling up to 60 meter depth;
- Spring development; and
- Deep water well drilling mainly for urban and semi urban towns.

The use of surface water for domestic water supply is not often practiced in the region. Adwa water supply and currently Axum water supply are the only towns in the region (2011) that use surface water source from the Dam built in the Adwa area. In 2010, the number of recorded water supply schemes was:

- 4,944 hand dug wells fitted with hand pump;
- 1,265 developed spring sources;
- 3,655 shallow well sources equipped with hand pump; and
- 186 motorised water sources in the region.

From the above schemes, 481 hand dug wells (9.73%), 375 (10.26%) shallow wells, 254 (20.08%) springs and 18 (9.8%) motorised schemes were non -functional schemes (2011). From the total water supply schemes in the region in 2010, 1128 (11.2%) water supply schemes were non-functional.

No social infrastructure was noted to be located on the IAIP site itself or in the vicinity. It was indicated that all the healthcare, religious and schooling infrastructure for the area is located in Baeker (town) and the surrounding area. A summary of local level infrastructure and services is provided in **Table 8-23**.

Table 8-23: Summary of Local Level Infrastructure and Services

Infrastructure & Services	Details
Electricity	Majority of households do not have reliable and non-intermittent access to electricity, although some residents are reported to have access to electricity through the use of private generators.
Water	Currently there is no formal water supply system to the site. The closest town, Baeker Town also does not have a centralised water supply system. Local settlements customarily access water through hand dug wells, and any seasonal streams where the level of water depends on the seasonal availability of water. The use of such water sources often results in water borne diseases. Availability of water to the site area is limited. Groundwater is not a source used by inhabitants of the site and its surrounds as there were no accessible boreholes or wells in close proximity to the site. The majority of people living around the site rely on water supply from hand dug wells.
Waste Management Facilities	Waste Management facilities or services are largely absent across the local area. The construction of the IAIP and RTCs could lead to increased levels of waste and litter dumped in open areas, so this issue will be explored further at the ESIA stage.
Telecommunications	Beaker has access to the national mobile telephone network and there are fixed telephone services. Access in other settlements is variable; however it is increasingly common for local residents in all villages to have mobile phones. It was noted however, that the network is not always reliable, and there is frequent loss of signal in settlements.
Education	Beaker has one first cycle (1-4) primary school and one complete primary school (1-8). There is one secondary school level teaching children up to grade eleven.
Health	There is one governmental health centre, two private pharmacies and one rural drug vender. According to the standard set by the ministry of Health one health centre can serve to 25,000 populations. Baeker Health Centre is enough for the 9608 population size.

ECONOMY AND LIVELIHOOD ACTIVITIES

The economy of the Zone and most Woredas is centred on the production of sesame, which by 1996 replaced cotton as the primary cash crop. Sesame is a high-value edible oil that is exported to Israel, Turkey, the Middle East, Japan and China. The second most important crop traded is sorghum, which is traded locally all year round. Demand for sorghum on the local market increases during the peak hunger months of June, July and August, when prices also increase Sorghum is exported to Gondar and to the central regions of Tigray.

The Sesame and Sorghum growing area is spread across Kafta Humera, Tsegedie, and Welkait Woredas in Western Tigray. This area is predominantly a lowland zone, though the southern tip of Kafta Humera and parts of western Welkait Woredas are mountainous and lay in midland. Sesame production is labour intensive especially during the weeding and harvesting period. It attracts over 200,000 workers from Tigray, northern Amhara and Sudan each year. In the Kafta Humera Woreda, sesame production is semi-mechanised and tractors are hired for land preparation. Local farmers mainly sell their sesame to large-scale marketing enterprises through locally established marketing cooperatives.

Cattle, sheep and goats are the primary livestock which is usually sold when they are at least 8 months old. Cattle are traded when they are at least 18 months old, though they are sold less often as compared to sheep and goats. The main market for livestock is Sudan.

The availability of water for both human and animal consumption is a serious problem in the Region. In most cases, water is purchased from hand pumps and some households have no choice but to

drink from rivers and ponds. Drinking from open water sources exposes local communities to water-borne diseases.

CULTURAL HERITAGE

Tigray National Regional state hosts one of the nine World Heritage sites found in Ethiopia. Aksum and its environs are among those listed in the World Heritage List of UNESCO. It is found in the Central Zone of Tigray in Aksum town. The ruins of the city Aksum, dating from the 1st to the 13th century, mark the heart of ancient Ethiopia. It consists of monolithic obelisks, giant stelae. Royal tombs, and ruins of former castles.

There are no registered cultural and historical sites in the Woreda which includes the Baeker area. Though its historical significance is not well elucidated and officially registered, the Kafta Humera Woreda Culture and Tourism Office states that there is a military camp near Baeker town which was built during the Italian aggression in the 1940s. The military camp is found at the northern gates of Baeker town, on the road to Humera town. It is a distance of 10kms from the IAIP.

The military camp is expanded and is still used by the Ethiopian Defence Forces. The Kafta Woreda Culture and Tourism office has not carried an assessment on the historical significance of the buildings in the military camp and what it constitutes as they do not have access for security reasons. Therefore this site is not currently registered by the Kafta Woreda Culture and Tourism Office and is not preserved as historical heritage. In the absence of detailed information identifying the state of buildings in the camp, there is no way by which we can include it in our impact assessment.

8.16.3 BASELINE ENVIRONMENT – MAI KADRA RTC

GENERAL

Socio-economic details and data at the country- and regional-level are provided in Sections 8.16.1 and 8.16.2, while this section provides details on the local level, where the information was obtained from public sources and primary data collected in the RTC area.

The proposed Mai Kadra RTC site is located in the West Tigray Zone of the Tigray Region. Nine PAPs were identified as those whose land will be fully or partially affected by the development of the Mai Kadra RTC facilities. Later in 2016, the Government paid compensation to the RTC affected households.

There are a total of 32,400 people in the town, 17,413 are males and 14,977 are females. On the whole there are 7780 households from which 5175 are male headed and 2805 are female headed. The main ethnicity in the area is Tigray but there are also other ethnicities such as Amhara and Agew. Predominantly Tigrigna and to some extent Amharic languages are spoken in the area. Many of the residents are Orthodox Christians however there are also Muslims although they are few in number. There was and still is migration (mainly seasonal) to the area in large numbers especially during the harvesting season in search of work and daily labor for it is Cash Crops such as Sesame and Cotton that are produced in the area. It is from different regions that migrants came but mainly from Southern Ethiopia.

It was reported that the local government has already reached agreements in terms of compensation and discussions already been concluded with all of the affected parties. It is understood that the affected farmers would only receive replacement farmland, without the provision of financial compensation.

ECONOMY AND LIVELIHOOD

Currently, labour activities in the area include farming and raising cattle as well as a considerable number of traders. Mai Kadra has favourable vast land that is productive for agricultural production for low-land, arid crops such as sesame, sorghum and cotton.

SOCIAL INFRASTRUCTURE AND SERVICES

In Mai Kadra there are three primary schools and one high school; however, both are insufficient due to the shortage of classes and chairs. Similarly, there is only one health centre and it is insufficient as

it is not compatible with the current population size and has a shortage of medics and equipment. Patients whom are referred to hospital have to travel to Humera which is 27km away since there is no hospital in town.

There is one police station in the town but there are limited policemen; as a result, it is the militia that mostly keeps the order.

CULTURAL HERITAGE

No churches, burial sites or other form of cultural resources are noted to be located on the site. The area was not indicated to be known for palaeontological and/or archaeological resources.

8.16.4 SOCIO-ECONOMIC PROFILE OF PEOPLE IN THE PROJECT AREA (BASED ON WSP SURVEY)

A team of local specialists guided by the WSP team carried out a household survey in Baeker and Mai Kadra towns, where based on the resettlement process initiated by authorities, 40 people will be economically and physically affected: 31 people were identified as affected by the development of the Baeker IAIP and 9 people were identified as affected by the development of the Mai Kadra RTC.

The WSP team was targeting mainly those people who identified themselves as being affected by the project (and therefore involved in the resettlement process initiated by local authorities) and who still reside at the site. The WSP team thus interviewed in total 20 people who are affected by the project and currently reside in the vicinity of either the Baeker IAIP or May Kadra RTC sites.

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 his family, thus collecting the data on the wider circle of local residents.

GENDER AND AGE

Both women and men were encouraged to participate in the household survey which resulted in approximately 70% and 30% of the questionnaires being answered by men and women, respectively.

All of the respondents chose to disclose their age. 20% of the questionnaires were answered by people who were between 24-35 years of age, 30% were between 36-45 year olds, 20% were between 46-55 year olds, 25% were between 56-65 year olds and 5% were >66. Around three quarters of all respondents were noted as being in their mid-20s to mid-50s (70%) (see **Figure 8-31** below).

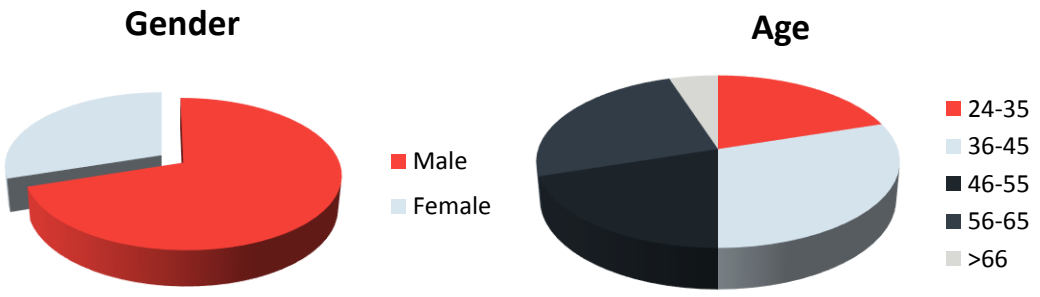

Figure 8-31: Respondents' gender and age

Of the respondents, 50% were residing in the Baeker town for the proposed IAIP and 50% were residing in the Humera town for the proposed RTC which helped to create a balanced insight into the affected people at both sites.

EDUCATION

Two thirds of respondents within the 56-65 and >66 age group reported having had no form of education (67%). However, those in the 24-35 year age bracket had either a primary education (25%) high school education (25%) or a Higher/University Degree (25%), with a quarter of 24-35 year old respondents having received only some or no primary education (25%).

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 20.4% had not finished their basic schooling or had no education. This compares favourably with the reported Tigray regional statistics, with 85% of surveyed females and 80% of surveyed males receiving only some or no primary education.

In contrast, a large proportion of the family members (61.1%) included in the surveys finished a primary school at a minimum.

The surveys showed that a much lower percentage of family members went on to further education, with 11.1% and 7.4% as having a high school education and a Higher/University Degree education level, respectively. There were no respondents reporting having a Technical Diploma. In summary, low education attainment levels were noted among the interviewed affected people in the project area, where the majority of interviewees and their immediate adult family members mostly finished a primary school.

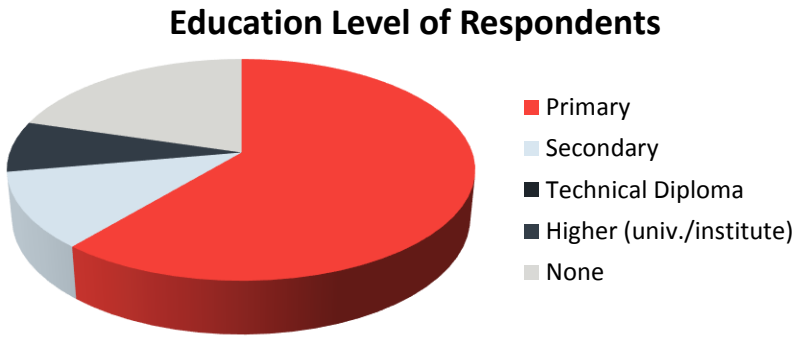

Figure 8-32 : Reported educational level among respondents

EMPLOYMENT

The employment profile also has been further enhanced by asking about the employment situation of other family members, in addition to the employment data on interviewees themselves. Over half (55.6%) of the respondents defined themselves as a farmer, while 15% of the respondents defined themselves as either a civil servant (7.5%) or employed within a business or trade (7.5%).

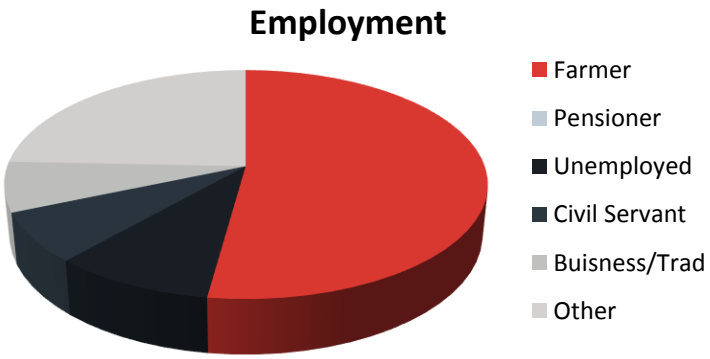

Figure 8-33 : Reported employment among respondents

All of the respondents' spouses were employed, with 75% stating farming as their primary occupation. The questionnaires showed that 10% of the respondents were unemployed. This is a significantly low level of unemployment that was expected in the project area.

In addition, 26% of the interviewees gave their occupation as 'Other'. Other occupations were mentioned, too including a daily labourer, student, etc.

ASSET OWNERSHIP

Although most of the respondents have irregular and unpredictable income (derived mainly through agricultural activities), ownership of electronic goods in the interviewed households was high.

The majority of the respondents stated that they owned the following assets: a mobile phone was owned by 95% of the respondents, a television and satellite dish by 85%, a refrigerator was owned by 50% and a radio was also owned by 50% of the surveyed households.

However, 90% of respondents have no access to the internet in their homes and none of the respondents had access to a washing machine in their homes.

85% and 70% of the surveyed respondents are currently living in the houses or have land that belong to them (owner-occupiers), respectively. Furthermore, 75% owned goats or chickens, which demonstrates how important animal husbandry is for supplementary income in the survey area.

Personal transport ownership is low, with only 10% of respondents stating they owned a car and another 10% of respondents stating they owned a bike. It should be noted that one of the households participating in the questionnaire owned both a car and a bike, indicating that personal transport ownership is even lower than the percentages originally suggest.

The survey asked respondents to list any areas of cultural heritage within the area. Exactly a quarter of the respondents (all from Baeker town) stated that there were areas of cultural significance located nearby, whilst 75% of respondents stated that there were not. Areas of cultural heritage reported included the Siye Park, Sheraro National Park and the Kalay Agob (Holly Water); the distance of these areas from the wider project area ranged from 5km to 40km. Respondents were also asked the distance to the nearest cemetery from their home, this ranged from 0.2km to 1.5km, with an average of 1.07km.

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. This is a much better response rate than could have been expected in such a survey.

All of the respondents indicated that they derive most of their income from farming/ agricultural activities or from formal employment (civil servant, business or daily labourer). In addition, 35% 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 one or more of these activities, as detailed in **Table 8-24** below.

Table 8-24 : Details on Alternative Sources of Income

Alternative Source of Income	Households receiving income from these activities
Chicken and Goats	25%
Money from Family Members	10%

Among the respondents, the average household income from all livelihood sources and obtained from all working age family members totals to approximately 37,947 Birr/year (equivalent to $1,392. Nov 2017 exchange rate). The estimated annual per capita (per person) household income data from the WB (2016) show that an average per capita annual income in Ethiopia is $660/person. Assuming that there are two working persons in an average household (statistically, 4.8 people per household in Ethiopia), the obtained income data is in line with the World Bank 2016 data.

When asked about their monthly expenditures, 55% 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, food expenditure.

The next most important expenditures for the respondents appeared to be 'other', an answer given by 35% of respondents. All of the answers given as 'other' were relating to farming or fertiliser expenses, which ranged from 330 to 5,000 Birr/month depending on the size of the cultivated plot. Other expenditures included 'utilities' which was given by 20% of respondents and 'housing' which was given by 10% of respondents.

SOURCES OF FRESHWATER

It was reported that only 5% of the households obtain freshwater from the lorry that regularly makes water deliveries. The main source of freshwater was identified as a water pump with 50% of households stating it as their main source, whilst 45% reported that they attain freshwater through 'other' resources.

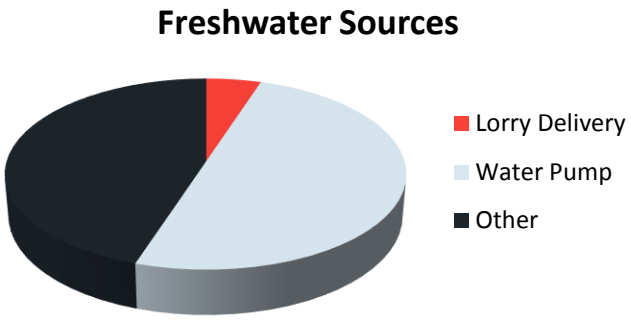

Figure 8-34: Sources of freshwater

HEALTH SITUATION

25% of the respondents indicated that at least 1 member of their household has a disability or an illness. Half of the disabilities within the households were noted down in the questionnaires as handicapped and the half attributed the disability to mental disorder. It should be noted that a hearing disability was mentioned in addition to a mental disorder for one family member.

The respondents listed the following top three diseases to have affected members of their household in the past three years: malaria, typhoid and flu.

The survey asked questions regarding recent deaths and births in families. All of the respondents stated that there had been no deaths in the past year whilst 5% reported that there had been one birth in the household. Although this is a somewhat low fertility level, this is in line with the recent research into fertility levels in Tigray, published in 2014 (Mjaaland, 2014).

PROJECT EXPECTATIONS

All respondents were aware about the Project, of which most (75%) of them have primarily learnt about through a local authority announcement, but around a third had learned about the Project through mass media, as well as the local community.

90% 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 the area and market for agricultural products.

Only 10% of respondents reported expecting some negative impacts from the Project; these included worries about environmental pollution, but mostly regarding the displacement of farmers with little or no compensation.

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 Tigray IAIP and RTC. These impacts have been sourced from various specialist reports, refer to appendices 9-1 – 9-12 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 Tigray IAIP and RTC site developments and to identify potential cumulative risks to the identified soils and the level of associated mitigation measures that will be needed. 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 10-1** summarises the impacts identified at both the Tigray 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 Tigray Region, refer to **Appendix C-1.**

Table 9-1: Potential Impacts on Soils in the Tigray Region

Impact number	Description	Character	Ease of Mitigation	Pre-mitigation Rating	Post-mitigation Rating
CONSTRUCTION					
1	Erosion Soil erosion is not a big problem at the Tigray IAIP and RTC sites as the soils have not yet been disturbed, but development of these areas, especially on the shallow soils which make up half of the IAIP site, will lead to erosion during the construction phase	Negative	Low	Major	Moderate
2	Sedimentation Eroded soil particles may end up in a nearby watercourse as well as the watercourse which runs through the south west corner of the IAIP site resulting in sedimentation	Negative	Low	Major	Moderate
3	Loss of topsoil	Negative	High	Moderate	Negligible

Impact number	Description	Character	Ease of Mitigation	Pre-mitigation Rating	Post-mitigation Rating
	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				
4	Compaction A change in the soils' original structure, which should be limited during the construction phase	Negative	Moderate	Major	Moderate
5	Change in surface profile The surface profile of the sites will be changed to create a platform for the agri-industrial zone buildings	Negative	Nil	Major	Major
6	Change in land use The land will undergo permanent changes as the land use will change from farming 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 If bare surfaces and soil stockpiles are not watered and vegetated, there will be high amounts of dust creation	Negative	Moderate	Moderate	Minor
9	Contamination Contamination occurs due to the large vehicles; on-site pollutants' contact with the well-drained soils will need to be limited to decrease chances of contaminating water resources	Negative	Moderate	Major	Minor
OPERATIONAL					
1	Groundwater Contamination Potential contaminants relate to micro biological	Negative	Low	Moderate	Moderate

Impact number	Description	Character	Ease of Mitigation	Pre-mitigation Rating	Post-mitigation Rating
	contamination from faecal waste originating from septic tank and sewage system discharge, infiltration of domestic waste and unlined pit latrines.				
2	Sedimentation Eroded soil particles may end up in a nearby watercourse, which runs through the IAIP site, as sedimentation	Negative	Low	Moderate	Moderate
3	Compaction Large amounts of compaction occur during this phase, resulting in the soil structures to be permanently changed	Negative	Nil	Major	Major
4	Dust creation If bare surfaces and soil stockpiles are not watered and vegetated, there will be high amounts of dust creation	Negative	Moderate	Moderate	Minor
5	Contamination Contamination should be prevented otherwise well-drained after contact with the pollutants; the type of pollutants released in this phase differ to pollutants in other phases	Negative	Moderate	Moderate	Minor
DECOMMISSIONING					
1	Erosion Soils with a soil shallow depth are highly susceptible to erosion; implement mitigation measures to prevent eroded areas from spreading	Negative	Low	Major	Moderate
2	Sedimentation Eroded soil particles may end up in a nearby watercourse, which runs through the IAIP site, as sedimentation	Negative	Low	Moderate	Minor

Impact number	Description	Character	Ease of Mitigation	Pre-mitigation Rating	Post-mitigation Rating
3	Dust creation If bare surfaces and soil stockpiles are not watered and vegetated, there will be high amounts of dust creation	Negative	Moderate	Moderate	Minor
4	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	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 included in **Chapter 11**. The residual impacts on the soil as a result of the development will include the following:

- Soil Erosion: Although mitigation is possible, excavation of soils is generally likely to lead to some 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 soils of the Tigray sites may enter the surrounding water resources.
- Mitigation measures can be very expensive and require appropriately-skilled personnel to be a part of the impact mitigation team.

9.2 SURFACE WATER

This section of the report is to identify the potential risks associated with the surface water at the proposed project site. There is no permanent flowing surface water resource on the site. The Semina River, which crosses the site, is a seasonal water course flowing in the heavy rainy season only. There is also a wider and larger flood channel which is heavily affected by erosion.

The storm water management plan developed by MACE was reviewed. 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. Please note that the sizing of storm water infrastructure was not considered as part of the review.

- UNOPS- Design Planning Manual, Version 1, 2014 (UNOPS, 2014);
- IFC World Bank Group- Environmental Health and Safety (EHS) Guidelines: General Environmental Guidelines, 2007 (IFC, 2007);

- African Development Bank Group- Safeguards and sustainability series, Volume 2, Issue 1, December 2015: Integrated Safeguards System (ADBG, 2015).
- 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 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. To view the full report with regards to potential impacts on surface water within the Tigray Region, refer to **Appendix C-2.**

9.2.1 STORM WATER MANAGEMENT PLAN REVIEW

The storm water management drainage design undertake by MACE for the IAIP and RTC sites were reviewed to ensure that these designs are in accordance with relevant legislation.

The Tigray IAIP (Baeker) drainage system has two summer storage tanks that capture majority of runoff water generated on the site. Overflow form the summer storage tank is discharged to the natural environment. A total of ten discharge points are proposed for the site. An area of concern for the Baeker storm water management is that runoff generated on the solid waste management plant and sewage treatment plan enter the clean (drainage system points AK and BF drains) system and is discharged to the natural environment. It is possible that these areas can be considered 'dirty' and runoff generated there could be contaminated. It is proposed that runoff from these two areas rather be directed to the summer storage tanks and used within the plant process.

The Tigray RTC (Mai Kadra) drainage system consists of four discharge points. Runoff generated on the site is discharged to the surrounding environments. Discharge point 1, 3 and 4 directs water to the drainage line located on the southern boundary of the site which drains under the culvert of the highway. Discharge points direct clean water to a culvert situated in the northern section of the site. An area of concern for the Mai Kadra storm water management is that runoff generated on the solid waste management plant and sewage treatment plan is directed to the clean system (B drainage system) which drains to discharge point 1. It is possible that these areas can be considered 'dirty' and runoff generated there could be contaminated. It is proposed that runoff from these two areas rather be directed to the summer storage tanks and used within the plant process.

The table below identifies the potential impacts on surface water and the significance of the impact.

Table 9-2: Potential Impacts on Surface Water in the Tigray Region

Impact number	Description	Character	Ease of Mitigation	Pre-mitigation Rating	Post-mitigation Rating
CONSTRUCTION					
1	Hydro-carbon contamination of the Semina River from the earth-moving machinery and vehicles	Negative	Low	Moderate	Minor
2	Sedimentation of the Semina River and drainage line	Negative	Moderate	Moderate	Minor
OPERATIONAL					
1	Altering the hydrological regime- Change in Runoff Volume	Negative	Moderate	Moderate	Minor

Impact number	Description	Character	Ease of Mitigation	Pre-mitigation Rating	Post-mitigation Rating
2	Altering the hydrological regime-Change in runoff velocity	Negative	High	Moderate	Minor
DECOMMISSIONING					
1	Hydro-carbon contamination of the Semina River from the earth-moving machinery and vehicles	Negative	Moderate	Moderate	Minor
2	Sedimentation of the Semina River and drainage line	Negative	Moderate	Moderate	Minor

The surface water impacts identified above can be suitably mitigated through the implementation of protection strategies, refer to the Environmental and Social Management Plan 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 put in place.

9.3 GROUNDWATER

Based on primary data obtained, groundwater use in the vicinity of the Baeker IAIP site is relatively limited, with no active groundwater abstraction/utilisation points being identified within the proposed Project boundaries. Two shallow hand dug wells were identified in the area, one of which had been dug in a stream channel. Water levels in these wells were relatively shallow, with water levels of 0 metres and 7.1 metres below surface recorded in the two wells respectively. 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 Tigray Region, refer to **Appendix C-3.**

Table 9-3: Potential Impacts on Ground Water in the Tigray 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	Moderate	Moderate	Minor
2	Contamination of groundwater resources from contaminated surface water runoff or subsurface leakages from underground chemical storage and/or effluent systems	Negative	Moderate	Moderate	Minor

Impact number	Description	Character	Ease of Mitigation	Pre-mitigation Rating	Post-mitigation Rating
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 Tigray IAIP and RTC will have a minor impact on the receiving groundwater environment.

9.4 WETLANDS

Given the fact that there are no wetland features on the site it would not be necessary to undertake a wetland assessment in the ESIA phase. This aspect has been scoped out of the ESIA.

9.5 AIR QUALITY

The purpose of this Air Quality Impact Assessment is to identify the potential impacts and associated risks posed by the construction and operation of the proposed IAIP site on the air quality of the area. The outcomes of the impact assessment will provide a basis to identify the key risk drivers and make informed decisions on the way forward in order to ensure that these risks do not result in unacceptable social or environmental risk.

Current baseline ambient air quality was tested at the Tigray Baeker IAIP site in order to identify the risks associated with the proposed IAIP project that may change the air's chemical composition and dust levels. Meteorological data was also obtained to further monitor potential impacts on air quality. The amount of atmospheric pollutants emitted through vehicles, domestic fuel burning and agricultural activities have been calculated in order to identify all potential risks.

The nearest town of Baeker is located approximately 10 km to the southeast of the IAIP site. The town of Mai Kadra is located to the immediate north of the proposed RTC site. Other sensitive receptors located in close proximity to the IAIP and RTC sites include subsistence farming and small homesteads. The table 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 Tigray Region, refer to **Appendix C-4**.

Table 9-4: The Potential Impacts on Air Quality in the Tigray Region

Impact number	Receptor	Character	Ease of Mitigation	Pre-mitigation Rating	Post-mitigation Rating
CONSTRUCTION					
1	Residential Receptors located within immediate vicinity of site boundary Increased particulate and gaseous concentrations	Negative	Moderate	Moderate	Minor
2	Residential Receptors beyond site boundary Increased particulate and gaseous concentrations	Negative	Moderate	Minor	Negligible

Impact number	Receptor	Character	Ease of Mitigation	Pre-mitigation Rating	Post-mitigation Rating
OPERATIONAL					
1	Residential Receptors within immediate vicinity of site boundary Increased particulate and gaseous concentrations	Negative	Moderate	Moderate	Minor
2	Residential Receptors beyond site boundary Increased particulate and gaseous concentrations	Negative	Moderate	Minor	Negligible
DECOMMISSIONING					
1	Residential Receptors within immediate vicinity of site boundary Increased particulate and gaseous concentrations	Negative	Moderate	Moderate	Minor
2	Residential Receptors beyond site boundary Increased particulate and gaseous concentrations	Negative	Moderate	Minor	Negligible

It should be noted that the below rating is 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.

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;
- 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 air quality within the Tigray Region, refer to **Appendix C-5**.

9.7 NOISE

The current noise climate is typically rural, with very limited anthropogenic influences. The site currently consists of farming activities which do not generate significant levels of noise. The only identifiable source of noise source at the IAIP site is the highway, which connects Gondar and Humera, which borders the site on its northern boundary. Therefore noise levels are anticipated to increase substantially within the area with the introduction of the Tigray IAIP and RTC, based on the fact that there is a lack of noise prior to the development of the proposed project.

Based on a worst-case cumulative sound power level of 116.3 dB(A) stemming from all construction equipment operational during the construction phase, the resultant noise levels at specified distances from the source are predicted to be high. From 50 m from the source, noise levels will reduce considerably, with noise levels at around 78m 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 a worst-case cumulative noise level of 107.6 dB(A) stemming from activities at the meat processing unit, noise levels in the immediate vicinity of the meat processing unit are predicted to be high. At further distances from the source, noise levels will reduce considerably, 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.

The table below identifies the potential impacts of 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 Tigray Region, refer to **Appendix C-6**.

Table 9-5: Potential Impacts of Noise in the Tigray Region

Impact number	Receptor	Character	Ease of Mitigation	Pre-mitigation Rating	Post-mitigation Rating
CONSTRUCTION					
1	Neighbouring homesteads (up to 500	Negative	Moderate	Major	Moderate

Impact number	Receptor	Character	Ease of Mitigation	Pre-mitigation Rating	Post-mitigation Rating
	m from the site boundary) will be directly impacted by construction activities Degradation of noise climate / annoyance				
2	Receptors further than 500 m from the IAIP site will be minimally impacted by construction activities and owing to the low current background noise Degradation of noise climate / annoyance levels	Negative	Moderate	Moderate	Minor
OPERATIONAL					
1	Residential receptors within 500m of the site boundary Degradation of noise climate / annoyance	Negative	Moderate	Moderate	Minor
2	Residential receptors beyond 500m of the site boundary Degradation of noise climate / annoyance	Negative	Moderate	Minor	Negligible
DECOMMISSIONING					
1	Residential receptors within 500m of the site boundary Degradation of noise climate / annoyance	Negative	Moderate	Major	Moderate
2	Residential receptors beyond 500m of the site boundary Degradation of noise climate / annoyance	Negative	Moderate	Moderate	Minor

Key localised acoustic impacts associated with the IAIP site include:

- Construction phase impacts of noise on residential receptors; and
- Operational phase impacts of noise on residential receptors.

The impact assessment has identified that the construction and decommissioning phases will generate the most significant impacts, however these can be managed through the implementation of the ESMS.

9.8 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. However, 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 9.6.

To view the full report with regards to potential impacts on transport and access within the Tigray Region, refer to **Appendix C-7**.

Table 9-6: Potential Impacts on Transport and Access in the Tigray Region

Impact number	Receptor	Character	Ease of Mitigation	Pre-mitigation Rating	Post-mitigation Rating
CONSTRUCTION					
1	Increased vehicle volumes on the local roads may impact on the safety of the community in the area, especially vulnerable non-motorised transport users (pedestrians, cyclists, etc.)	Negative	Low	Minor	Minor
OPERATIONAL					
1	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.	Negative	Low	Moderate	Minor
DECOMMISSIONING					
1	Increased vehicle volumes on the local roads may impact on the safety of the community in the area, especially vulnerable non-motorised transport users (pedestrians, cyclists, etc.)	Negative	Moderate	Minor	Minor

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 will be provided on-site, and parking on individual erven will be subject to the Development Control Regulations of the sites. The parking provision will be in-line with the zoning of each internal erf of the IAIP and RTC.

There are no residential areas or villages in the vicinity of the IAIP and RTC sites, since they are in excess of 10 km from the town of Baeker and 1.5km to the town of Mai Kadra respectively. Public transport will therefore be required to transport workers to the site. 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 remote location of the site, non-motorised transport will be negligible along the access road, and no special requirements are recommended.

9.9 WASTE MANAGEMENT

In the Baeker and Mai Kadra towns, there are no organized 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 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 9-7: Potential Risks Associated with Waste Management in the Tigray Region

Impact number	Receptor	Character	Ease of Mitigation	Pre-mitigation Rating	Post-mitigation Rating
CONSTRUCTION					
1	Construction waste: discarded or broken bricks, packaging and hazard demarcation tape	Negative	High	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,	Negative	Moderate	Moderate	Minor

Impact number	Receptor	Character	Ease of Mitigation	Pre-mitigation Rating	Post-mitigation Rating
	surface and ground water.				
3	Any wastes being ultimately disposed of at a landfill will contribute the volumes of waste and hence the lifespan of the landfill.	Negative	High	Major	Negligible
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. A Waste Management Plan (WMP) has been developed for the Tigray IAIP and RTC sites. 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, Enterprise and Contractors. 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. The WMP is included in **Appendix C-8**.

9.10 VISUAL

The potential visual impacts were assessed during the scoping phase and given that visual impacts may occur as a result of the proposed Project but would most likely be of low to insignificant minor insignificance, given the remote nature of the site and the limited visibility of the site, no further assessment is proposed. In addition, 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.

9.11 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.

The table below indicates how the biodiversity within the Baeker IAIP region may be impacted by the proposed development.

To view the full report with regards to potential impacts on biodiversity within the Tigray Region, refer to **Appendix C-9**.

Table 9-8: Potential Impacts on Biodiversity at the Baeker IAIP in the Tigray Region

Impact number	Receptor	Character	Ease of Mitigation	Pre-mitigation Rating	Post-mitigation Rating
CONSTRUCTION					
1	Wetland No wetlands has been recorded in this proposed project area	Negative	Moderate	Negligible	Negligible
2	Biodiversity Loss/clearance of vegetation, especially South West part of the proposed project Stakeholder consultation at the Tigray site did highlight potential impacts on the forest resource in the area as a result of labour influx to the IAIP who are likely to use the wood for domestic purposes	Negative	Moderate	Major	Minor
3	Biodiversity Loss/clearance of vegetation/scattered tree stands	Negative	Low	Minor	Negligible
4	Biodiversity and habitat Impact on the underneath growth and shift on natural water course caused by the stockpiling of excavation soils, waste rubble and excess materials	Negative	Moderate	Major	Minor

Impact number	Receptor	Character	Ease of Mitigation	Pre-mitigation Rating	Post-mitigation Rating
5	Habitat / streams Water quality deterioration	Negative	Moderate	Moderate	Minor
6	Habitat / wetland Lowering water table	Negative	High	Negligible	Negligible
OPERATIONAL					
1	Wetland Loss/degradation of wetland	Negative	Moderate	Negligible	Negligible
2	Biodiversity Loss/clearance of vegetation	Negative	High	Negligible	Negligible
3	Biodiversity Revegetation of indigenous plant species in a buffer and greenery area	Positive	Low	Moderate	Major
4	Biodiversity and habitat Impact on the underneath growth and shift on natural water course	Negative	High	Negligible	Negligible
5	Habitat / streams Water quality deterioration/Pollution	Negative	Moderate	Minor	Negligible
6	Habitat / wetland Lowering water table	Negative	Moderate	Negligible	Negligible
DECOMMISSIONING					
1	Wetland Loss/degradation of wetland	Negative	Moderate	Negligible	Negligible
2	Biodiversity Loss/clearance of vegetation	Negative	High	Negligible	Negligible
3	Biodiversity Maintaining revegetated indigenous plant species in a buffer and greenery area	Positive	Low	Minor	Major
4	Biodiversity and habitat Impact on the underneath growth and shift on natural water course	Negative	High	Negligible	Negligible
5	Habitat / streams	Negative	Moderate	Minor	Negligible

Impact number	Receptor	Character	Ease of Mitigation	Pre-mitigation Rating	Post-mitigation Rating
	Water quality deterioration / Pollution				
6	Habitat / wetland Lowering water table	Negative	Moderate	Negligible	Negligible

The table below indicates how the biodiversity within the Mai Kadra RTC region may be impacted by the proposed development.

Table 9-9: Potential Impacts on Biodiversity at the Mai Kadra RTC in the Tigray Region

Impact number	Receptor	Character	Ease of Mitigation	Pre-mitigation Rating	Post-mitigation Rating
CONSTRUCTION					
1	Wetland No wetlands has been recorded in this proposed project area	Negative	Moderate	Negligible	Negligible
2	Biodiversity No natural vegetation has been recorded in this proposed project area except weeds that remained from farming activity	Negative	Moderate	Negligible	Negligible
OPERATIONAL					
1	Wetland No wetlands has been recorded in this proposed project area	Negative	Moderate	Negligible	Negligible
2	Biodiversity No natural vegetation has been recorded in this proposed project area except weeds that remained from farming activity	Negative	High	Negligible	Negligible
3	Biodiversity Revegetation of indigenous plant species in a buffer and greenery area	Positive	Low	Moderate	Major
DECOMMISSIONING					
1	Wetland Loss/degradation of wetland- no wetland habitat has been recorded	Negative	Moderate	Negligible	Negligible

Impact number	Receptor	Character	Ease of Mitigation	Pre-mitigation Rating	Post-mitigation Rating
2	Biodiversity Loss/clearance of vegetation- No natural vegetation has been recorded	Negative	High	Negligible	Negligible
3	Biodiversity Maintaining revegetated indigenous plant species in a buffer and greenery area	Positive	Low	Minor	Major

9.12 SOCIO-ECONOMIC

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 Baeker IAIP and Mai Kadra 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 Tigray Region, refer to **Appendix C-10**.

9.12.1 EMPLOYMENT AND THE ECONOMY

Based on preliminary estimates, the construction stage of the Project will generate a range of new jobs/employment opportunities during construction and new jobs during operation. The estimated direct employment is presented in the table below based on the proposed phasing of the development, see **Table 9-10**. Although these are preliminary estimates and caution needs to be exercised when citing these numbers.

In addition, the proposed Baeker IAIP and Mai Kadra RTC sites will require goods and services throughout its 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 employment opportunities. This is referred to as indirect employment.

Table 9-10 : Predicted Employment Numbers as a result of the operational phase IAIP and RTC in the Tigray Region

Employment Type	Year 1	Year 2	Year 3	Year 4	Year 5
Direct employment	262,885	327,687	392,718	458,091	519,538
Indirect Employment	394,327	491,531	589,077	687,137	779,307

Source: MACE

Although employment numbers are not available for the construction phase, it is reasonable to assume that the number of people employed by the Project will decrease at the end of the construction phase (the construction process lasting approximately 15 years).

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 a skill set 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 on a much higher demand for new businesses in the region and the limited number of existing businesses, it is anticipated that the number of opportunities to create 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** (15 years of construction) 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 as moderate positive impact does not need mitigation.

For transparency purposes, the social impacts are presented in Appendix A of the Socio-economic report (refer to **Appendix C-10**) in a series of self-explanatory tables which if needed, could be used by the developer in their management reporting.

9.12.2 LAND ACQUISITION AND IMPACT ON LIVELIHOODS

Based on the information received, WSP team site observations and consultations with the affected people, 40 PAPs will be affected during the construction stage of the Tigray IAIP Project, through both economic and physical displacement. 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 Tigray started the resettlement process a year ago. As a result, some affected people received compensation and moved on, while some either did not receive compensation or at the moment do not have plans to move. 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 lose harvest opportunities, etc.

Further impact and mitigation for the resettlement process has been provided in a separate resettlement action plan (RAP) for the Tigray IAIP and RTC sites.

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 construction and operation in total) and of **medium** severity (mainly due to the fact that some of the affected people received alternative plots and others are currently in the process of finding one). The probability of the impacts is considered to be **high (**the government already started the resettlement process a year ago). The significance of this negative impact on project affected people's (PAPs) livelihood is therefore considered to be **major** negative and will require mitigation.

Although the PAPs will receive compensation, further best international practice mitigation measures will be suggested in a separate Tigray RAP.

9.12.3 COMMUNITY HEALTH

Although it is currently unknown the number of workers that will be employed during construction, 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.

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 IMPACT

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** (15 years of construction) 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.

9.12.4 COMMUNITY SAFETY AND SECURITY

There are a number of safety related issues that are likely to arise during the construction and operational stage of the project. These include:

- Traffic accidents - given the relatively low level of current road use and the fact that the project will have separate and secure/fenced off access roads, 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; and
- 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.

The Project will increase the number of vehicles on roads 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.

In addition, the Project will require security. Security personnel will be employed 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** (15 years of construction) 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 developer.

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.

9.12.5 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 impacts assessment can be found in Section 9.7 of this Report.

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**.

9.12.6 COMMUNITY INFRASTRUCTURE AND SERVICES

The construction period is expected to last over 15 years and during this time, it is anticipated that 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 Tigray 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 operation 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. 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 Tigray 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 become 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 **low** to **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 **medium**. The significance of the impacts is therefore considered to be **moderate**.

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. As such, the impact severity is therefore considered **very low** and the probability of the impacts occurring is **medium**. The significance of the impacts is therefore considered to be **minor**.

SUMMARY OF SOCIO-ECONOMIC IMPACTS

Development of the proposed project has the potential to result in significant socio-economic impacts. The table below provides a summary of a demographic, cultural and economic overview of the Project Area and also describes the physical infrastructure and services available in the Social Study Area. The purpose of collecting this information is to provide baseline data for conducting the impact assessment and to monitor and measure changes against the potential future changes 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 Tigray Region, refer to Appendix 9.11.

Table 9-11: Potential Impacts on the Socio-Economic Sector in the Tigray Region

Impact number	Receptor	Character	Ease of Mitigation	Pre-mitigation Rating	Post-mitigation Rating
CONSTRUCTION					
1	An increase in employment opportunities and demand for goods and services are positive. The impact is long-term because it occurs during the construction phase which will last for an estimated 15 year period. The Project will provide employment opportunities for the wider Tigray region; therefore, the impact is regional.	Positive	Not Applicable	Major	Major
2	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 40 local farmers, where some of	Negative	Moderate	Major	Moderate

Impact number	Receptor	Character	Ease of Mitigation	Pre-mitigation Rating	Post-mitigation Rating
	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	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	Minor
4	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. The impact is limited to local settlements. Short-term impacts at relatively regular intervals during the construction phase.	Negative	Moderate	Moderate	Minor
5	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	Negative	Moderate	Moderate	Minor

Impact number	Receptor	Character	Ease of Mitigation	Pre-mitigation Rating	Post-mitigation Rating
	surrounding air quality, disrupting the amenity value of an area and potentially impacting community health (e.g. further aggravating respiratory illnesses).				
6	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.	Negative	High	Moderate	Minor
OPERATIONAL					
1	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 Tigray region; therefore, the impact is regional.	Positive	Not Applicable	Moderate	Moderate
2	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 40 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	High	Major	Minor
3	There is potential for the workforce to introduce and/or increase the rate of spread of communicable	Positive	Low	Moderate	Minor

Impact number	Receptor	Character	Ease of Mitigation	Pre-mitigation Rating	Post-mitigation Rating
	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.				
4	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.	Negative	High	Moderate	Minor
5	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 operational phase with the rare frequency.	Negative	Moderate	Minor	Minor
6	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.	Negative	Moderate	Minor	Minor
DECOMMISSIONING					
1	An increase in employment opportunities and demand for goods and services are positive. The impact is long-term because after decommissioning the permanent operation employment opportunities will be lost. The Project will	Negative	Moderate	Major	Moderate

Impact number	Receptor	Character	Ease of Mitigation	Pre-mitigation Rating	Post-mitigation Rating
	provide employment opportunities for the wider Tigray region; therefore, the impact is regional.				

From the table it is clear that land acquisition caused by the project will have a major negative impact on the affected farmers, both during construction and operation phases. As a result of the land acquisition process commencing prior to an international consultant's involvement there is the potential that not all historical land acquisition activities carried by the local authorities, are complying with the AfDB OS2 principals, although they are compliant with the national land acquisition regulations. This and other issues are covered in detail in a separate Tigray RAP along with recommendations on how these gaps can be addressed.

Based on the information collected during the field visit, consultation sessions and site observations the existing infrastructure and particular medical facilities are inadequate even for the existing population of the area. As a result it is highly likely that the existing facilities and infrastructure in the project area will not be able to cope with the increased demand for services during the construction stage in particular.

10 CUMULATIVE IMPACTS

The ESIA should investigate 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 Tigray IAIP and RTC. These impacts have been sourced from various specialist reports, refer to appendices 9-1 – 9-12 for the full reports. This chapter considers the cumulative effects that could arise from a combination of the Tigray 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 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. The description is based on primary data obtained from site investigations. **Table 10-1** summarises the impacts identified at both the Tigray 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 Tigray Region, refer to **Appendix C-1.**

Table 10-1: Potential Cumulative Impacts on Soils in the Tigray 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 on a cumulative effect on the site's identified soils	Negative	Low	Major	Major
2	Sedimentation Eroded soil particles may end up in a nearby watercourse, which runs through the IAIP site, 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; there is limited topsoil at the IAIP site	Negative	High	Moderate	Moderate
4	Compaction Soil compaction results in the change of the original structure	Negative	Low	Moderate	Minor
5	Change in surface profile	Negative	Nil	Minor	Minor

Impact number	Description of Impact	Stage	Ease of Mitigation	Pre-mitigation Rating	Post-mitigation Rating
	The surface profile of the sites will be changes to create platform for the agri-industrial zone buildings				
6	Change in land use The land will undergo permanent changes as the land use will change from farming to an agri-industrial zone	Negative	Nil	Moderate	Moderate
7	Change in land capability The proposed development will permanently alter the lands capability	Negative	Nil	Moderate	Moderate
8	Dust creation If bare surfaces and soil stockpiles are not watered and vegetated, there will be high amounts of dust creation	Negative	Moderate	Moderate	Minor
9	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	Negative	Low	Major	Minor

10.2 SURFACE WATER

This section of the report is to identify the potential risks associated with the surface water at the proposed project site. There is no permanent flowing surface water resource on the site. The Semina River, which crosses the site, is a seasonal water course flowing in the heavy rainy season only. There is also a wider and larger flood channel which is heavily affected by erosion.

The table below identifies the potential 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 Tigray Region, refer to **Appendix C-2.**

Table 10-2: Potential Cumulative Impacts on Surface Water in the Tigray Region

Impact number	Description of Impact	Stage	Ease of Mitigation	Pre-mitigation Rating	Post-mitigation Rating
1	Altering the flow regime of the Semina River	Negative	Moderate	Moderate	Minor

10.3 GROUNDWATER

Based on primary data obtained, groundwater use in the vicinity of the Baeker IAIP site is relatively limited, with no active groundwater abstraction/utilisation points being identified within the proposed Project boundaries. Two shallow hand dug wells were identified in the area, one of which had been dug in a stream channel. Water levels in these wells were relatively shallow, with water levels of 0 metres and 7.1 metres below surface recorded in the two wells respectively. 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 Tigray Region, refer to **Appendix C-3.**

Table 10-3: Potential Cumulative Impacts on Ground Water in the Tigray 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

10.4 WETLANDS

Given the fact that there are no wetland features on the site it would not be necessary to undertake a wetland assessment in the ESIA phase. This aspect has been scoped out of the ESIA.

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 atmospheric chemistry. The table below highlights the cumulative impacts of air quality. To view the full report with regards to potential impacts on air quality within the Tigray Region, refer to **Appendix C-4**.

Table 10-4: The Potential Cumulative Impacts on Air Quality in the Tigray Region

Impact number	Description	Character	Ease of Mitigation	Pre-mitigation Rating	Post-mitigation Rating
1	Residential Receptors within immediate vicinity of site boundary Increased particulate and gaseous concentrations	Negative	Moderate	Moderate	Minor
2	Residential Receptors beyond site boundary Increased particulate and gaseous concentrations	Negative	Moderate	Minor	Negligible

10.6 NOISE

The current noise climate at the IAIP site is predominantly a rural location with limited anthropogenic activities occurring, therefore noise levels are anticipated to increase substantially within the area with the introduction of the Tigray IAIP, based on the fact that there is a lack of noise prior to the development of the proposed project.

The table 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 Tigray Region, refer to **Appendix C-6**.

Table 10-5: Potential Cumulative Impacts of Noise in the Tigray Region

CUMULATIVE					
1	Residential receptors within 200m of the site boundary Degradation of noise climate / annoyance	Negative	Moderate	Moderate	Minor
2	Residential receptors beyond 200m of the site boundary Degradation of noise climate / annoyance	Negative	Moderate	Minor	Negligible

10.7 TRANSPORT AND ACCESS

There are no known large-scale latent developments in the vicinity of this development, therefore no Cumulative Transport Impacts are expected on the local road network.

- The Baeker Town Situation Report did not cover the IAIP site and surrounds, therefore any developments in the town will have a negligible impact on the site. The increased residential and commercial development of the town may therefore be a source of additional local labour and a market for products.
- The Mai Kadra Structure plan did not cover the RTC site and surrounds, therefore any developments in the town will have a negligible impact on the site. The report does note that the town can expand in all directions, except to the north. The increased residential and commercial development of the town may therefore be a source of additional local labour and a market for products.

10.8 WASTE MANAGEMENT

In the Baeker and Mai Kadra towns, there are no organized 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.

Table 10-6: Potential Cumulative Impacts Associated with Waste Management in the Tigray 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	Negative	Low	Major	Moderate

	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.				

10.9 VISUAL

The potential visual impacts were assessed during the scoping phase and given that visual impacts may occur as a result of the proposed Project but would most likely be low to insignificant minor insignificance, given the remote nature of the site and the limited visibility of the site, no further assessment is proposed. In addition, 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. This applies to all IAIP and RTC sites in Tigray.

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 Tigray Region, refer to **Appendix C-9**.

The table below indicates how the biodiversity within the Baeker IAIP region may be impacted by the proposed development.

Table 10-7: Potential Cumulative Impacts on Biodiversity in the Tigray Tigray IAIP

Impact number	Description of Impact	Stage	Ease of Mitigation	Pre-mitigation Rating	Post-mitigation Rating
1	Wetlands and habitats No wetland habitat has been recorded	Negative	Moderate	Major Negligible	Negligible
2	Biodiversity\ No cumulative impact has been observed	Negative	Moderate	Negligible	Negligible

The table below indicates how the biodiversity within the Mai Kadra RTC region may be impacted by the proposed development.

Table 10-8: Potential Cumulative Impacts on Biodiversity in the Tigray Mai Kadra RTC

Impact number	Description of Impact	Stage	Ease of Mitigation	Pre-mitigation Rating	Post-mitigation Rating
1	Wetlands and habitats No wetland habitat has been recorded	Negative	Moderate	Major Negligible	Negligible

Impact number	Description of Impact	Stage	Ease of Mitigation	Pre-mitigation Rating	Post-mitigation Rating
2	Biodiversity\ No cumulative impact has been observed	Negative	Moderate	Negligible	Negligible

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 a demographic, cultural and economic overview of the Project Area and also describes the physical infrastructure and services available in the Social Study Area. The purpose of collecting this information is to provide baseline data for conducting the impact assessment and to monitor and measure changes against the potential future changes 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 Tigray Region, refer to **Appendix C-10**.

Table 10-9: Potential Cumulative Impacts on the Socio-Economic Sector in the Tigray Region

Impact number	Description of Impact	Stage	Ease of Mitigation	Pre-mitigation Rating	Post-mitigation Rating
1	Pressure on existing infrastructure within Baeker Town and Mai Kadra, in particular medical facilities and education facilities.	Negative	Moderate	Major	Minor
2	Resettlement and land acquisition displacing farmers, their agricultural activities including crops and other assets	Negative	Moderate	Major	Minor
3	An increase of employment and diversity of employment will benefit the next generation by generating alternative revenue streams	Positive	Not Applicable	Major	N/A
4	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	N/A

10.12 CUMULATIVE IMPACTS

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 10-10**.

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.

Table 10-10: Cumulative Interactions between Multiple Potential Impacts for the IAIP and RTC

	Soils	Surface water	Ground water	Air quality	Noise	Waste management	Biodiversity	Socio-economic
Socio-economic	Minor	Moderate	Moderate	Minor	Moderate	Minor	Minor	
Biodiversity	Negligible	Negligible	Negligible	Negligible	Negligible	Negligible		Negligible
Waste management	Major	Major	Major	Moderate	Negligible		Moderate	Moderate
Noise	Negligible	Negligible	Negligible	Negligible		Negligible	Minor	Moderate
Air quality	Negligible	Moderate	Negligible		Negligible	Negligible	Moderate	Major
Ground water	Negligible	Moderate		Negligible	Negligible	Negligible	Major	Moderate
Surface water	Low		Major	Negligible	Negligible	Negligible	Major	Major
Soils		Major	Moderate	Moderate	Negligible	Negligible	Major	Moderate

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. Both the Baeker IAIP and Mai Kadra RTC sites selected are located within an agricultural zone where the economy is largely agrarian and people living in the area are engaged in the production of the major crops grown in the area. The closest urban settlement is Baeker to the IAIP and Mai Kadra to the RTC.

Baeker Town serves as a centre of labour workers at harvesting season and is therefore dominated by temporary structures serving as houses and services. Rural areas outside the Baeker Town occur predominantly in the northern and North West parts, limiting expansion options in this location. To the east of Baeker is a deep gorge which further limits urban expansion. Therefore, according to the Situation Report for the Preparation of the Structure Plan for Baeker Town (SSACA, 2012), the proposed expansion area for Baeker Town has been identified west of the current settlement area with one location being north of the main road through beaker. The total area proposed for urban expansion is 365ha. The report does not indicate proposed development being proposed 10km northwest of Baeker Town towards the proposed Baeker IAIP site. In addition, no information was provided by the IPDC on other proposed developments in the area, with the exception of the associated infrastructure requirements such as roads, powerlines and sanitation services infrastructure. All of these infrastructure projects will have a limited footprint for which mitigation of impacts can be simply achieved. Each of 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 Mai Kadra Structure plan did not cover the RTC site and surrounds, therefore any developments in the town will have a negligible impact on the site. The report does note that the town can expand in

all directions, except to the north. The increased residential and commercial development of the town may therefore be a source of additional local labour and a market for products.

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 any 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 Tigray 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 will 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	Negligible	Moderate
	2	Sedimentation	Negative	Low	Moderate	Moderate	Minor
	3	Loss of topsoil	Negative	High	Negligible	Negligible	Negligible
	4	Compaction	Negative	Moderate	Moderate	Major	
	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	Contamination	Negative	Moderate	Minor	Minor	Minor
	10	Groundwater Contamination	Negative	Moderate	Negligible	Moderate	Negligible
Surface Water	1	Hydro-carbon contamination of the Semina River	Negative	Low	Minor	Negligible	Minor
	2	Sedimentation of the Semina River and drainage line	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	Negative	Moderate	Negligible	Minor	Negligible
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 (up to 500m from the site boundary)	Negative	Moderate	Moderate	Minor	Moderate
	2	Degradation of noise climate / annoyance levels (further than 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

Environment	No.	Impact	Character	Ease of Mitigation	Post-mitigation Rating		
					Construction	Operation	Decommission
Waste Management	1	Inappropriate disposal of construction waste	Negative	High	Minor	Negligible	Minor
	2	Hazardous waste materials being stockpiled on bare ground	Negative	Moderate	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	Increased volumes of waste and impacting lifespan of landfills.			Negligible	Negligible	Negligible
	6	Disposal to unlined landfill impacting surface and groundwater resources.			Negligible	Minor	Negligible
Biodiversity (Baeker IAIP)	1	Loss/degradation of wetland	Negative	Moderate	Negligible	Negligible	Negligible
	2	Loss/clearance of natural forest vegetation,	Negative	Moderate	Minor	Negligible	Negligible
	3	Loss/clearance of natural vegetation	Negative	Low	Negligible	Major	Major
	4	Impact on the underneath growth and shift on natural water course	Negative	Moderate	Minor	Negligible	Negligible
	5	Water quality deterioration / pollution	Negative	Moderate	Minor	Negligible	Negligible
	6	Lowering water table	Negative	High	Negligible	Negligible	Negligible
Biodiversity (Mai Kadra RTC)	1	Loss/degradation of wetland	Negative	Moderate	Negligible	Negligible	Negligible
	2	Loss/clearance of natural vegetation	Negative	Moderate	Negligible	Negligible	Negligible
	3	Revegetation of indigenous vegetation	Positive	Low	Negligible	Major	Major
Socio-Economic	1	An increase in employment opportunities & demand for goods and services (although this will reverse to moderate negative during the decommissioning stage)	Positive	Not Applicable	Major	Moderate	Moderate
	2	Loss of access to agricultural land plots and in some cases, loss of residential buildings and other assets (crops).	Negative	Moderate	Moderate	Minor	Negligible
	3	Potential for the workforce to introduce and/or increase the rate of spread of communicable diseases in the project area.	Negative	Moderate	Minor	Minor	Negligible

Environment	No.	Impact	Character	Ease of Mitigation	Post-mitigation Rating		
					Construction	Operation	Decommission
	4	Potential safety and security risks in the local area.	Negative	Moderate	Minor	Minor	Negligible
	5	Nuisance from noise; vibrations and dust.	Negative	Moderate	Minor	Negligible	Negligible
	6	Strain, congestion, and wear and tear for roads and strain on medical facilities in the local area.	Negative	High	Minor	Minor	Negligible

The **non-implementation** of the project will impede development and delay the industrialisation of the agricultural industry in the Tigray 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 (Western Tigray), 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 (Western Tigray), 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; (iv) Demarcate the area to be stripped clearly, so that the contractor does not strip beyond the demarcated boundary. (v) The top 50cm of the entire area should be stripped, where the soils are deep enough, and relocated by truck along set removal paths. (vi) The area to be stripped requires storm water management; the in-flow of water should be prevented with suitable structures. (vii) Prepare the haul routes prior to stripping. (viii) Stripping should not begin in wet conditions.	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 (Western Tigray), 2017

Environment	No.	Potential Impacts	Proposed Mitigation and Benefit Enhancement Measures	Institutional Responsibility for Implementation	Timeframe / Due Date	Cost Estimates	Monitoring	Applicable Safeguards / Documents
			(ix) 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). (x) 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). (xi) The MEFCC 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. (xii) 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 Tigray 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. (xiii) 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. (xiv) 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. (xv) 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. (iii) Soils must not be stripped when they are wet as this can lead to compaction and loss of structure.	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 (Western Tigray), 2017

Environment	No.	Potential Impacts	Proposed Mitigation and Benefit Enhancement Measures	Institutional Responsibility for Implementation	Timeframe / Due Date	Cost Estimates	Monitoring	Applicable Safeguards / Documents
	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) As mentioned, the MEFCC 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 (Western Tigray), 2017
	S8	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	(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 (Western Tigray), 2017
Surface Water	SW1	Hydro-carbon contamination of the Samina river	(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 (Western Tigray), 2017
	SW2	Sedimentation of the Samina river and drainage line	(i) Appropriate placement and terracing of soil stockpiles, (ii) Appropriate drainage to be in place before construction takes place; (iii) Minimise the movement of heave 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 (Western Tigray), 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 **Appendix E-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 (Western Tigray), 2017

Environment	No.	Potential Impacts	Proposed Mitigation and Benefit Enhancement Measures	Institutional Responsibility for Implementation	Timeframe / Due Date	Cost Estimates	Monitoring	Applicable Safeguards / Documents
Noise	N1	Acoustic 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; - Contact details of a responsible person on site should complaints arise; and - Advise community on the grievance mechanism and grievance submission procedure. (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).	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 (Western Tigray), 2017
Transport and Access	T1		(i) It is recommended that due to the anticipated higher traffic volumes to and from the Baeker 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 roads authority. 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 (Western Tigray), 2017

Environment	No.	Potential Impacts	Proposed Mitigation and Benefit Enhancement Measures	Institutional Responsibility for Implementation	Timeframe / Due Date	Cost Estimates	Monitoring	Applicable Safeguards / Documents
Waste Management	WM1		(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. (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.	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 Regulations (Western Tigray), 2017 Waste Management Plan (Appendix 9.9 of ESIA)
Biodiversity	B1 B2	Natural habitats	The following mitigation measures are to be implemented. (i) Maximum effort is to be made to retain natural vegetation and natural habitats in all parts of the proposed project area; (ii) Establish proper waste management, especially liquid effluents so as not to pollute the natural vegetation, habitat and recipients such as streams and seasonal rivers that pass through or in close proximity to the project areas; (iii) Plant indigenous trees in open spaces / green buffer areas, as well as retain as much natural vegetation as possible within the areas to regenerate; (iv) Demarcate green buffer areas as no-go zones to retain natural habitat throughout construction period; (v) All staff are to be educated on how to maintaining remnant vegetation and the importance the habitat plays in stabilising the microclimate of the proposed project site and surrounding areas. (vi) Protect the forested areas within the vicinity of the sites, especially *Boswellia* tree species from which natural gum is harvested.	IPDC / Contractor Ministry of Environment, Forest and Climate Change (MEFCC), Tigray Regional EPLAUA and its associated Woreda level office	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 (Western Tigray), 2017
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,	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 (Western Tigray), 2017

Environment	No.	Potential Impacts	Proposed Mitigation and Benefit Enhancement Measures	Institutional Responsibility for Implementation	Timeframe / Due Date	Cost Estimates	Monitoring	Applicable Safeguards / Documents
			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.					
	SE2	Community Health	(ii) 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. (iii) 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. (iv) 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. (v) 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. (vi) Contractors' are to comply with national HSE legislation and the UNDP HSE Policies. (vii) The project implementation team is to carry out regular audits of the HSE Management system implementation by Contractors. (viii) Implementation of the Health and Safety Management Policy and Worker Influx Management Plan. (ix) Provide the Project HSE Policies and Worker Influx Management Policies to all contractors and subcontractors during formal induction, including security contractors (if applicable). (x) 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. (xi) The IPDC will ensure that Contractors will provide onsite first-aid tents (one tent per site) to ensure that basic medical attention and	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 (Western Tigray), 2017

Environment	No.	Potential Impacts	Proposed Mitigation and Benefit Enhancement Measures	Institutional Responsibility for Implementation	Timeframe / Due Date	Cost Estimates	Monitoring	Applicable Safeguards / Documents
			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 contractors will quickly provide transportation to the Workers' Camp clinic which will also help reduce the potential pressure on local healthcare facilities.					
	SE3	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 (Western Tigray), 2017
	SE4	Environmental Emissions	Refer to Air Quality Section of ESMP.					
	SE5	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 (Western Tigray), 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 (Western Tigray), 2017
	S2	Contamination	(i) One should maintain control of substances entering the site, (ii) Provide adequate disposal facilities, and (iii) Enforce a non-polluting environment. (iv) One should identify potentially toxic overburden and screen with a suitable material to prevent mobilisation of toxins.	IPDC	Throughout Operation	Covered in Project Budget	-	AFDB OS1, OS4 World Bank Group EHS Guidelines Development Corporation Regulations (Western Tigray), 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 (Western Tigray), 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 (Western Tigray), 2017
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 (Western Tigray), 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 (Western Tigray), 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
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 Western Tigray (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; (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.	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 (Western Tigray), 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
			(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 **Appendix E-2** for Sector Specific Guidelines.					
Noise	N1	Acoustic impacts Degradation of noise climate / annoyance on residential receptors within and beyond 200m of the site boundary	(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; - 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 Tigray 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	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 Regulations (Western Tigray), 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
			(v) Alert public when loud noise will be generated.					
Transport and Access	T1	Traffic impacts	(i) It is recommended that due to the higher traffic volumes to and from the IAIP, the configuration of at least one of the accesses should be improved to improve safety and operation of the access. 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) A suitable public transport stop should be provided on-site, to ensure safety of passengers waiting for transport. (iv) 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. (v) If the intersection performance deteriorates to unacceptable levels in future, additional intersection upgrades should be implemented.	IPDC	During construction and throughout Operation	Covered in Project Budget See Monitoring Plan Ref. 11.4.4.6	See Monitoring Plan Ref. 11.4.4.6	AFDB OS1 World Bank Group EHS Guidelines Development Corporation Regulations (Western Tigray), 2017
Waste Management	WM1		(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 Baeker, Mai Kadra and Humera which are the closest urban areas to the site, these wastes must be transported to the nearest sanitary landfill.	IPDC / Enterprises	Throughout Operation	Covered in Project Budget	-	AFDB OS1, OS4 World Bank Group EHS Guidelines Development Corporation Regulations (Western Tigray), 2017 Waste 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
			(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.					
Biodiversity	B1 B2	Natural habitats	The following mitigation measures are to be implemented. (i) Develop proper management measures for maintenance of the buffer and green areas to be protected on site. (ii) All staff are to be educated on how to maintaining remnant vegetation and the importance the habitat plays in stabilising the microclimate of the proposed project site and surrounding areas.	IPDC Tigray 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 (Western Tigray), 2017
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. 11.4.4.7	AFDB OS1, OS5 World Bank Group EHS Guidelines Development Corporation Regulations (Western Tigray), 2017
	SE2	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. (iv) 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.	IPDC	Throughout operation	Covered in Project Budget	See Monitoring Plan Ref. 11.4.4.7	AFDB OS1, OS5World Bank Group EHS Guidelines Development Corporation Regulations (Western Tigray), 2017
	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.	IPDC	Throughout operation	Covered in Project Budget	See Monitoring Plan Ref. 11.4.4.7	AFDB OS1, OS5World Bank Group EHS Guidelines Development Corporation Regulations (Western Tigray), 2017
	SE4	Environmental Emissions	Refer to Air Quality Section of ESMP.					

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
	SE5	Community Infrastructure and Services	(i) Develop and 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	Throughout operation	Covered in Project Budget	See Monitoring Plan Ref. 11.4.4.7	AFDB OS1, OS5World Bank Group EHS Guidelines Development Corporation Regulations (Western Tigray), 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 11-6** 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 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 PROGRAMME - CONSTRUCTION PHASE

11.4.3.1 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.

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** outlines the environmental monitoring required in relation to the construction phase of the Project.

11.4.3.2 SOIL EROSION

The EMU is to ensure the effectiveness of erosion and sedimentation control measures to be implemented during construction stage.

11.4.3.3 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.

11.4.3.4 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.

11.4.3.5 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 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.

11.4.3.6 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 these plans 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.

11.4.3.7 NATURAL VEGETATION

It is the responsibility of 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.

11.4.3.8 EQUIPMENT, FUEL STOAGE AND MAINTENANCE

It will be the responsibility of 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.

11.4.3.9 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 Programme - 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
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	Monitoring continuously	EMU / EPC Contractor	100,000 per year

No.	Parameter to be monitored	Location	Measurement	Frequency	Institutional Responsibility	Cost (Birr)
			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	Reporting bi-annually		
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 11-6**.

11.4.4.1 SOIL EROSION

The EMU is to ensure the effectiveness of erosion control measures to be implemented during the operation phase.

11.4.4.2 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

The surrounding water courses must be monitored on a **monthly** basis upstream and downstream of the IAIP site. Four surface water sampling locations have been identified as summarised in **Table 11-5**.

Table 11-5: Surface Water Sampling Locations

Sample name	Sampling Point	Latitude	Longitude
SW01	Water collection in erosion gulley	14.038056°N	36.781039°E
SW02	Downstream of the site - Semina River	14.06425° N	36.755249°E
SW03	Downstream of the site - drainage line	14.046244°N	36.769668°E
SW04	Upstream of site - drainage line	14.026689°N	36.767302°E

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. Tigray IAIP);
- Sample Location and Sample Type (e.g. Tigray 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 4^{o}C), 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.

11.4.4.3 GROUNDWATER MONITORING

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.

Monitoring boreholes should be placed both up gradient and down gradient of the operations, and take preferential groundwater flow paths into consideration. Groundwater monitoring should be conducted on a quarterly basis.

Should negative groundwater related impacts be identified, alternative water supply options should be supplied to the affected communities

11.4.4.4 AIR QUALITY MONITORING

Regular monitoring of ambient air quality in and around the site shall be conducted during the operation phase, following commencement of the park.

11.4.4.5 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.

11.4.4.6 TRAFFIC MONITORING

The trip generation of the IAIP and RTC facilities be monitored annually, during the operational phase, to ensure that the access intersections operate safely and with sufficient capacity and acceptable levels of service.

11.4.4.7 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.

11.4.4.8 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 MEFCC 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 MEFCC) 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 11-6: Monitoring Programme - Operation Phase

No.	Parameter to be monitored	Location	Measurement	Frequency	Institutional Responsibility	Cost (Birr)
1	Surface Water Quality	Upstream and downstream of the IAIP at 4 identified locations	Sampling and analysis Physical, chemical parameters	Monthly	IPDC/EMU	100,000 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
7	Environmental Monitoring Coordination	-	Monitoring of the implementation and success of the mitigation measures Reporting on monitoring results, and compliance with relevant legislation,	Monitoring continuously and Reporting bi-annually	EMU	Covered in operation cost

No.	Parameter to be monitored	Location	Measurement	Frequency	Institutional Responsibility	Cost (Birr)
			contract and technical requirements			
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.

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 11-7**.

Table 11-7: 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 PROJECT GRIEVANCE AND REDRESS MECHANISM

11.9.1 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.

11.9.2 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.

11.9.3 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.

11.9.4 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.

11.9.5 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.

11.10 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.

11.10.1 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.

11.10.2 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, Tigray'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.

11.10.3 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.

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 Table 1-3 which provides a summary of what each Chapter is required to contain 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, air quality, climate change, noise, transport and access, waste management, biodiversity, socioeconomic and cultural heritage on the functionality of the Project.

The majority of impacts were assessed to be of minor negative significance with mitigation. The major and moderate residual negative effects of the project arise from the risk of pollution of soils, noise from construction and decommissioning activities, waste management, social impacts on people who need to be resettled and the impact decommissioning the facilities would have 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 revegetation of indigenous plant specialist in the buffer and greenery areas and an increase in employment opportunities and demand for goods and serviced in the region.

A number of measures have been identified as necessary to minimize and control the risk of erosion and water pollution to surrounding farming activities. Water use and pollution would need to be monitored in the future to limit residual effects on other water users and aquatic ecosystems.

Based on the census data collected by the IPDC, the proposed Tigray Project (including the IAIP and RTC facilities) will result in 40 PAPs being economically displaced by the proposed development, where the project footprint will cover the land plots cultivated by these 40 PAPs. The development causes economic displacement and not physical displacement. A RAP has been developed as part of the Project, which focuses on displacement issues in more detail. These PAPs will be provided with compensation measures discussed in the Tigray RAP.

The project also has a number of benefits that have been identified, mainly associated with economic well-being of the local community. The industrialisation of the agricultural sector provides employment transition opportunities for farmers and their children. The Beaker IAIP and Mai Kadra RTC would increase incomes, provide greater food security and more employment opportunities.

It must be noted that during this ESIA process, construction works for the boundary wall had already commenced and therefore some of the impacts included in this report include impacts from existing construction activities. Commencement of construction without receiving an environmental certificate does not follow the traditional environmental certificate process and this issue should be looked into by IPDC.

The Stakeholder Engagement process as part of the Project has been summarised in Chapter 7 of this ESIA. 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. The ESMP represents Tigray Industrial Parks Development Corporation’s commitment to address and manage the potential negative and positive impacts associated with the Baeker IAIP and Mai Kadra 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 Tigray IAIP and RTC.

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APPENDIX

A MEFCC LICENCE FOR ZGEC

APPENDIX

B STAKEHOLDER CONSULTATION

APPENDIX

C SPECIALIST REPORTS

APPENDIX

C-1 *SOILS*

APPENDIX

C-2 *SURFACE WATER*

APPENDIX

C-3 *GROUNDWATER*

APPENDIX

C-4 *AIR QUALITY*

APPENDIX

C-5 *CLIMATE CHANGE*

C-6 NOISE

APPENDIX

C-7 *TRANSPORT AND ACCESS*

APPENDIX

C-8 *WASTE MANAGEMENT PLAN*

APPENDIX

C-9 *BIODIVERISTY*

APPENDIX

C-10 *SOCIO-ECONOMIC*

APPENDIX

D ESIA CONSOLIDATED IMPACT SIGNIFICANT MATRIX

APPENDIX

E AIR QUALITY MITIGATION RECOMMENDATION TABLES AS PER THE ESMP

APPENDIX

E-1 RECOMMENDED MITIGATION MEASURES FOR GENERAL CONSTRUCTION

APPENDIX

E-2 *RECOMMENDATIONS TO REDUCE EMISSIONS DURING THE OPERATIONAL PHASE*