ENVIRONMENTAL IMPACT ASSESMENT
SCOPING REPORT

ENVIRONMENTAL IMPACT ASSESSMENT FOR THE PROPOSED ESTABLISHMENT OF THE LISELO IRRIGATION FARM IN EASTERN ZAMBEZI REGION-NAMIBIA

CEGEOR

CENTER FOR GEOSCIENCES RESEARCH

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May 2022

PROJECT DETAILS

SCOPING REPORT ENVIRONMENTAL IMPACT ASSESSMENT FOR THE PROPOSED ESTABLISHMENT OF THE LISELO IRRIGATION FARM, AT LISELO IN ZAMBEZI REGION.

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CENTER FOR GEOSCIENCES RESEARCH

NAME	Mulife Siyambango
RESPONSIBILITY LEAD CONSULTANT	Director of Centre for Geosciences Research cc
QUALIFICATIONS	B. Sc. in analytical, inorganic and physical chemistry, Geography & Environmental Studies, M. Sc. in Industrial Rocks and Minerals, MBA in Banking, Accounting and Strategic Management.
PROFESSIONAL REGISTRATION	Pr.Sci.Nat
EXPERIENCE	Mr Siyambango is the director and founder of Centre for Geosciences Research cc Mr Siyambango is a qualified geologist, and specialist in industrial minerals and rocks. Obtained an **MSc in Industrial Rocks and Minerals** with majors in Mineral Resource Assessment & Estimation; Mineral Extraction & Management Marketing of Industrial Rocks and Minerals, Geology and Technology of Industrial Rocks and Minerals. **Mr Siyambango** is a fully trained and qualified Chemist with a **BSc in analytical, inorganic and physical chemistry**. Extensively trained and experienced in analytical instruments that are essential for mineral exploration and mineral processing. Academically and experienced trained Manager, with an **MBA in Banking, Accounting and Strategic Management**. The qualification supplements the economic assessment of commerciality of mineral resources for assessment of the bankability.
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1. SECTION 1: BACKGROUND

1.1. Introduction

The Tulela Agriculture (pty) Ltd (Proponent), a Namibia Company has applied for 5000 hectares of land from the Zambezi Communal Land Board in the Liselo area of Zambezi region. Of which the initial 1000 hectares is the envisaged development immediately for irrigated and rain fed maize crop.

On behalf of Tulela Agriculture (pty) Ltd CEGEOR cc has been appointed to undertake Environmental Impact Assessment studies. The assessment is to produce a scoping Environmental Impact Assessment (EIA) Study for the design, build, operate the Liselo irrigation farm at Liselo in Zambezi Region.

This document provides information on the benefits of the proposed Liselo irrigation project, potential impacts of the project and proposed environmental studies required to be monitored. P ublic participation during the EIAprocess forms part of the process. Information sharing is the cornerstone of successful Public Participation andyour input will help ensure that all potential issues are taken into consideration before critical decisions are made.

The 5000ha Liselo Maize irrigation farm involves upgrading dry land to irrigation farming through the construction and installation of a submissible water pump from the Zambezi river at Winela. station over a distance of 6km PVC pipeline. The Irrigation Scheme is earmarked to provide much needed labour based jobs within the Liselo area.

Figure 1 :Some Liselo Community members at Liselo Khuta, Zambezi Region.

The proposed Tulela Agriculture Irrigation maize project at Liselo is an initiative by Tulela Agriculture (pty) Ltd project aimed at uplifting the local community (Fig 1) in Liselo area through application of resilient agricultural production of the maize crop all year round. The community has shown keen interest in maize production and skills transfer from Tulela Agriculture (pty) Ltd. To improve the food security in Zambezi region, Zambezi Regional Council together with the Mafwe Traditional Authority has agreed to inter into a 50 year lease agreement with Tulela Agriculture (pty) Ltd over the Liselo project comprising of 5000ha.

Tulela Agriculture (pty) Ltd development at Liselo farm is meant to increase efficiency of Zambezi river water ultilisation, safe-guard people's lives; improve irrigation efficiency, and reducing pollution.

In view of the novelty of the proposed project, this could potentially become a test-bed and blueprint for other areas in the Zambezi region or Namibia at large with access to perennial rivers. In addition Tulela Agriculture (pty) Ltd is also interested to transfer skills to the community with technology and high-value inputs such as seeds preservation and equipment. The community stands to benefit from commercializing Liselo Maize farm unit and skills acquisition – potentially lifting communities out of poverty permanently by providing long term jobs.

With this short background, it is further reiterated that Tulela Agriculture (pty) Ltd proposes to construct and manage the Liselo Maize irrigation project, Land leased from the Mafwe Traditional authority which is already disturb or been previously been used by the community for dryland rain fed crop farming.

In line with Environmental Management Act No.7 of 2007 and its Environmental Impact Assessment Regulation of 2012, the proposed project is a listed activity which cannot be undertaken without an environmental assessment. Therefore, it is required that an environmental assessment is carried out for the proposed community project, to ensure the protection of the environment and community members found in that particular vicinity of the proposed project area. For this reason, an Environmental Expert was appointed to undertake an Environmental Impact Assessment (EIA) and Environmental Management Plan (EMP) for the construction, operational and decommissioning phases of the Liselo irrigation Project.

1.2. The objectives of the Environmental Assessment Process

The objectives of the Environmental Assessment process are as follows:

- Ensure integration of projects into their environment and socio-economic setting.
- Avoid irreversible damage to the environment, and ensure compliance.
- To inform the public about the proposed irrigation project and solicit their input/comments/suggestions

1.3. Terms of Reference

Terms of reference" means a document which forms part of an EIA report and sets out how an assessment must be carried out. The terms of reference for the

proposed project have been set out based on the requirement by the Environmental Management Act no.7 of 2007 and the Environmental Impact Assessment Regulation of 2012. The steps which were followed are described as follows:

a) a description of all tasks to be undertaken as part of the assessment process,including any specialist studies to be included if needed;
b) an indication of the stages at which the Environmental Commissioner is to beconsulted;
c) a description of the proposed method of assessing the environmental issues andalternatives; and
d) The nature and extent of the public consultation processes to be conducted during the assessment process.

1.4. Scope of the Environmental Impact Assessment (EIA)

The particular objectives of the EIA in line with the Terms of Reference are to:

- Comply with Namibia's Environmental Assessment Policy, Environmental Management Act no. 7 of 2007 and its Environmental Impact Assessment Regulations of 2012.
- Confirm the justification of the project and to consider all alternatives that would meet the need;
- Consult all Interested and Affected Parties (I&APs) to ensure that their inputs are taken into account;
- Review the legal and policy framework and their relevant requirements for this project;
- Describe the biophysical and socio-economic environment of the project and determine the associated sensitivities to and suitability for the proposed project.
- Identify and assess impacts related to the pre-construction, construction and operation of the Liselo Irrigation Project and to propose suitable mitigation strategies;
- Compile an Environmental Management Plan for the pre-construction; construction and operation of the Liselo irrigation project.

2. SECTION 2: PROJECT DESCRIPTION

2.1. Rationale of the project

The project is located at Liselo, Katima Mulilo (fig 2) rural constituency in Zambezi Region. The Katima Mulilo rural constituency in Zambezi Region has a population of 28,362 (Census 2010). The project is taking place in the Zambezi Region of Namibia, Sub-SaharanAfrica's wetlands with abundant loam soil due to annual rainfall average rain fall of 169.4mm in the month of January. Zambezi Region is the country's most prone wet with perennial rivers and humid region.

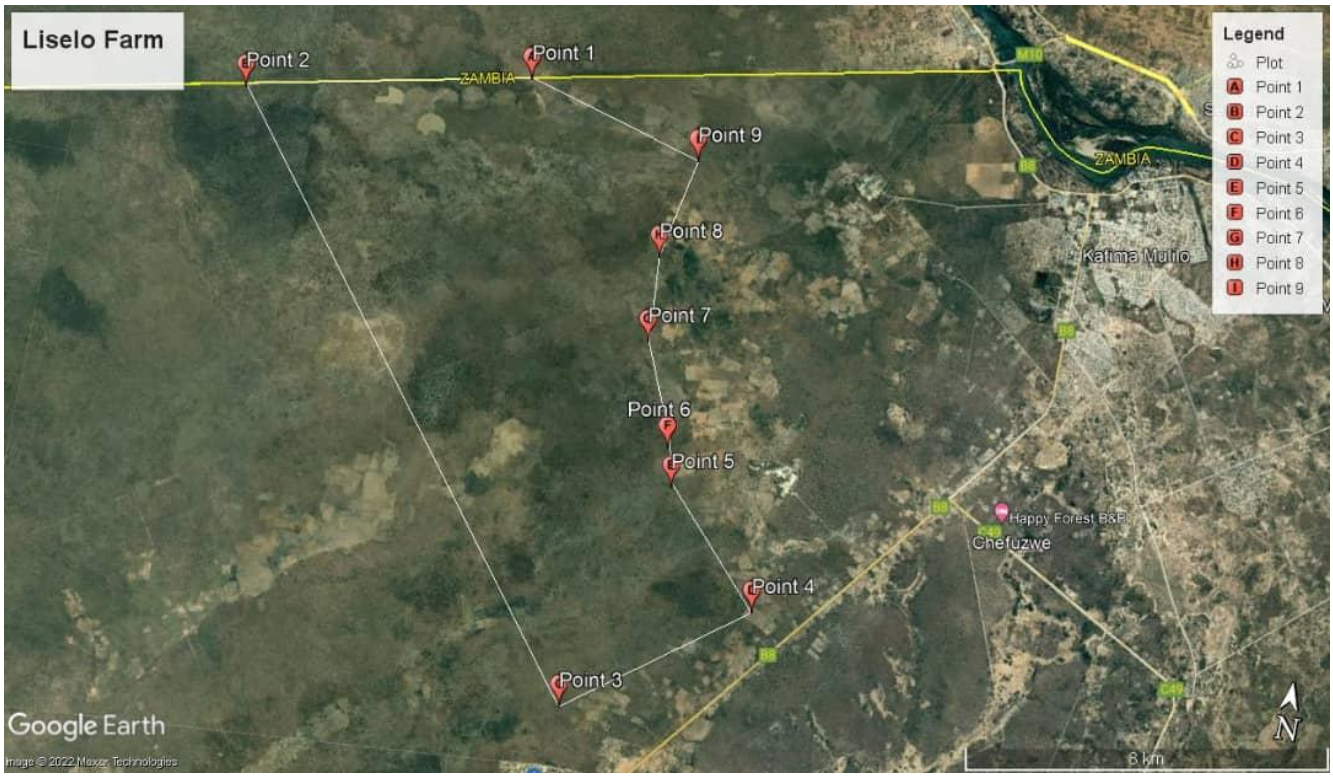

Figure 2, The location of the project area, Tulela Liselo Irrigation Agriculture farm project at Liselo in Katima Mulilo Rural Constituency.

This part of the Zambezi Region made up of native Namibians; the Liselo community faces challenges of poverty, HIV and high unemployment among the youth.

2.2. Project description

The proposed Tulela Agriculture Liselo Maize Irrigation Farm will occupy a 5000ha. In of community land and will consist of the following infrastructure as shown in **figures 2 and 3** below:

- River Pump Station
- Power Distribution
- Irrigation Fields
- Farm Buildings

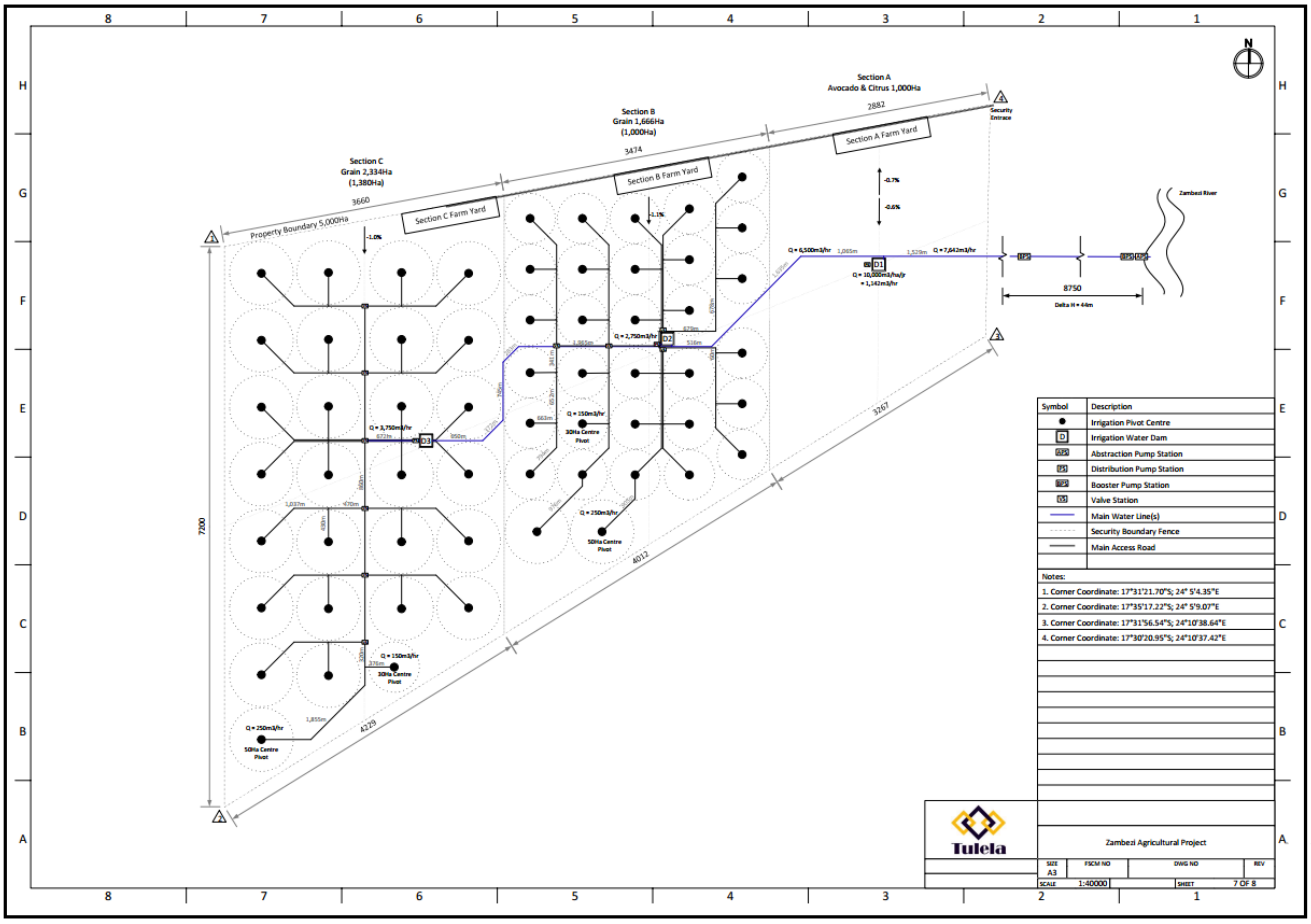

Figure 3 : The initial 1000 ha land to be developed showing the irrigation route water line from Zambezi river.

2.3. Project locality

The Tulela Agriculture Liselo Maize Irrigation Farm is located approximately 10km East of Katima Mulilo town bordering with the Winela farm (Image 1). The total area the community allocated to the project under lease hold for 50 year is 5000ha, with an initial 1000ha to be developed immediately for maize irrigation, (**Figure 2**).

Liselo farm is located in the east of Katima Mulilo town, close to the perennial

Zambezi River bordering with Zambia and Namibia (**Figure 3**). The Liselo Irrigation Maize Farm is parallel to the B8 Trans-Caprivi highway. To the Liselo farm area there is no watersupply apart from dug wells and underground boreholes. The proposed project area is on land with minor cultivation for dryland crops (primarily maize). Water will be abstracted from the Zambezi river by using a submissible pump near Winela border Post (**Figure 3**).

2.4. Farming management concept

For Tulela Agriculture Liselo Maize Irrigation Farm , the 'farm management concept options' considered is a purely commercial project constructed and operated as an irrigation farming operation by the Tulela Agriculture (pty) Ltd. This would mean the community can only benefit on skills transfer and job.

The Tulela Agriculture (pty) management to be employed are skilled and experienced managers with extensive professionally experience. The professional management would be responsible for the profitable running of the Liselo Irrigation farm, and the 'board' will be essential in formulating strategic decisions on behalf of the company. Since profitable irrigation farming is contingent on high-quality management, precise agronomic expertise, a skilled and specialised workforce and favourable climatic conditions is essential.

2.5. Proposed production systems and cropping for Tulela Agriculture Liselo Maize Irrigation Farm

2.6.1. Irrigation/Production area size

The area under lease for a 50 year at Liselo development is a 5000ha, with the initial development of the 1000 ha immediately. This means at the peak of the project a total of about 5000ha will be developed into irrigation plots equipped to produce cash crops within the period under lease. The sprinklers will operate with pressurized water from the Zambezi River with a controlled pressure pump or from a high-up situated reservoir. This requires additional investments in terms of larger pumps and stronger pipes than required by other systems. However, due to its improved effectiveness compared to surface irrigation systems, this could be a worthwhile consideration.

2.6.2. Cropping Options

Namibia is not self-sufficient in most cash crops such as Maize, citrus fruits and vegetable production. Hence an approximately more than 50% of the cash crops consumed are imported, mainly from South Africa. Maize, wheat and millet are also controlled crops in Namibia with a secure market. Table 1 illustrates the production of vegetables in Namibia and the quantities imported.

Table 1: Crops of interest at Liselo farm with an indication of what the consumption in Namibia is and what part is imported as a % of the total consumption(2011)

	Production, 1000 tonnes	Domestic supply, 1000 tonnes	Export, 1000 tonnes	Import, 1000 tonnes	Net Trade, 1000 tonnes
Maize	54	103	0	14	-14
Onions	20	21	0	1	-1
Wheat	16	75	0	59	-59
Fruits	43	62	16	35	-19

2.6.3. Crops under consideration for Tulela Agriculture Liselo Maize Irrigation Farm

Maize is the main target of production. Wheat can be included because it is one of the staple foods and has a structured market. Maize and wheat can be included at an early stage of the cropping programme (planting maize and wheat on the whole plot) in the beginning of the program since maize and wheat have a reliable market and are relatively easy to plant.

Apart from the maize farming as the project progress, the following crops can be considered for irrigation at Liselo's 5000ha:

- **Root crops**: Sweet potato (272 ton imported/yr. 40% of consumption), carrot (840 ton imported 40% imported), beetroot (135 ton imported 40% of consumption),
- **Leafy crops**: Cabbage (217 ton imported 14% of consumption), lettuce (438 ton imported 40 % of consumption) and Swiss chard.
- **Fruit crops**: Tomato (1460 ton imported 47% of consumption), Green pepper (39ton imported 8% of consumption), Beans (111 ton imported 68% of consumption), Butternut squash (79 ton imported 14% of consumption),

Pumpkin(29 ton imported 7% of consumption).

- **Other crops**: onions (4 ton imported .01% of consumption), Spring greens (19 ton imported 35% of consumption).

Tulela Agriculture (pty) Ltd, will start its main crop of maize as winter irrigated to summer rain fed crop (Maize is not very sensitive to crop rotation) and wheat as a winter crop, and introduce vegetables into the program as the local Liselo community members becomes familiar with irrigation and planting of vegetables. After the local community are equipped with the relevant training and a secure market of crops like Habanero chilies those will be required to reduce wild life human conflict, they will be able to generate income.

Normally it would be easier for a farmer to plant one crop, because of ease of management, but if a problem occurs with this crop type, the farmer could lose everything. Diversifying crops lowers the risk of failure. All the crops mentioned above are crops for which Namibia is not yet self-sufficient, with the exception of onions. The Liselo community and surrounding villages, can benefit from the produce by selling the vegetables to the open market at Katima Mulilo.

In the cropping model the area planted for a crop should also be of a size that allows the produce to be marketed easily (staggered planting) and the Tulela Agriculture (pty) Ltd should be able to sell the total crop with no problem. This will ensure that there is no over production of a particular crop.

The soils in the area are is moderately sandy and will be susceptible to degradation, especially with various crop production. It is therefore important to have a cropping pattern that will have a conservation effect on the soil fertility. It is advisable that that Tulela leave a section of land for at least one year, or to plant it with a green manure crop that can be incorporated in the soil to build organic matter. Organic matter or compost should also be applied to the soil to increase organic matter content of the soil.

Mango, Papayas, Avocado and Guava trees can also be planted to boost a diversified crop production for commercial purposes. For these crops, some

winters can be too cold and although summer high temperatures of above 35˚C can be tolerated, they can negatively affect yield.

2.6.4. Climate of the Tulela Agriculture Liselo Maize Irrigation Farm

Since the temperature at Liselo farm varies between temperatures of 8° to 27˚C in the winter and 15 to 35˚C in the summer it will that is moderate ideal climate for the afore-mentioned Maize and other crops. The production of Miaze is suitable especially during the hot season. Although when temperature are higher.

2.6.5. Skills transfer to local community as basic farming skills and experience

Tulela Agriculture (pty) Ltd has interest in transfer of agriculture skills to the local communities. Specifically skills can be transferred in cash crop farming such as Maize and vegetable production. Basic training in agronomic principles or experience in the field is essential; some managerial skills are also important and can enhance business competitiveness. In the absence of this, the applicant together with the workforce should be prepared to undertake training in horticulture production principles and farming business concepts.

It will be essential that the local community farmers be supported with an extension service to assist themwith mentoring in crops production, value adding and other needs. Therefore, it will be essential for Tulela Agriculture (pty) Ltd to collaborate with extension service provided by the Ministry of Agriculture, Waterand Forestry (MAWF) already engaged in such exercise.

2.6.6. Protective clothing

It is advisable that Tulela Agriculture (pty) Ltd 's employees working under such conditions be advised to have (provided)protective clothing for safety purposes.

2.6.7. Laborer farm tools

Table 2: List of the basic tools for general agronomic operations by laborer's.

Table 2: Irrigation or garden tools

Item	Quantity	Unit cost N$	Total cost N$
Garden Tools			
Wheel barrow	2	400	1200
Spade	2	150	450
Digging fork	3	300	900
Garden Rake	3	80	240
Weeding hoe	5	150	750
Hand spade	3	50	150
Hand fork	3	50	150
Knapsack sprayer	1	350	350
Irrigation equipment	1	25000	25000
Total		**29690**	
Protective clothing			
Gum boots	4	150	600
Hand gloves	4	50	200
Overall	4	250	1000
Face Masks	4	50	200

2.6.8. Handling requirements

Liselo area has very hot summers and therefore it is essential for the Farm to have handling and storing facilities when harvesting the crops. Harvesting will normally start early in the morning or if needed late in the afternoon. Tulela will erect a crop sorting shed or shelter while packing and value adding of the crop. On site also will be a cool room that will be to the benefit of the Project. Maize storage silos will be very essential on site.

2.6.9. Soils and fertilizer requirements

The map IN (Fig 4) provides the results of soil samples previously analyzed, giving a good idea of the quality of soil. The soil samples in Zambezi Region were taken at various sites, including the Liselo area as documented by the Ministry of Lands and Resettlement. Though not representative of the entire area, they provide a good indication of the soil nutrient levels for crop production.

Figure 4 .Showing the soil sample quality (Ministry of Lands and Resettlement)

2.6.10. Soil quality

The Liselo farm area comprise of sand to sand loam soil. The Liselo area has a dominance of fertile soils which are generally sand loam soil. This type of soil is suitable for crop farming.

2.6.11. Water requirements

According to CROPWAT calculations, in an average year the amount of water needed to irrigate every 50ha would be 145m^3/hour (equivalent to 7 mm/day). This would generally apply when daytime temperatures do not exceed 33˚C and minimum temperatures don't exceed 15˚C. In extremely hot and dry weather, water requirements for wheat and maize production could increase to nearly 320 m^3/h (equivalent to 18.4 mm/day). In the area in question these conditions could occur, for example, in September (35˚C day and 25˚C night temperatures). Normal practice in Namibia is to design irrigation systems with a potential to irrigate 12 mm/day or more. This translates to a requirement of 6,000 m^3 per day (or 250 m^3/hour/24hours) required to irrigate every 50 ha. A cropping pattern of maize and wheat would generally have a higher water usage than most other cropping patterns, thus an irrigation design that suits a wheat and maize pattern will normally be sufficient for other cropping patterns.

For the Tulela Agriculture Liselo Maize Irrigation Farm , it is recommended that water application of 12 mm/day (250 m^3) will besufficient in normal conditions per 50ha. In extreme conditions up to 18 mm/day (460 m³) could be needed.

2.6.12. Labour

Labour availability in the project area is crucial because crop production is labour intensive and as such requires adequate manpower for all operations. Tuelela in its business plan identifies that at least on inception of the project 25 labourers will be employed. Duringpeak periods (planting, weeding and harvesting) however the demand may increase and casual labour will need to be hired to attend to the work during the peak periods. It is clear that weeding requires the most labour at about 20 hours/1000 m² plot; i.e. about 12.5 labourers per plot of 0.5 ha for the growing period. In a cropping season, 4 to 5 farm workers are required to do the weeding. The rate N$ 3.7 per hour is the minimum salary for farm workers, and has been used to calculate the minimum labour cost.

2.6.13. Markets

The economy in the Zambezi Region is largely non-commercial farming activities, despite more number of maize hammer mills. However several subsistence farming is predominant. And can be observed at the local open market.

2.6. Infrastructure requirement

2.7.1. Existing Infrastructure

The development of linear infrastructure will include building such as the water pump room, a mechanical workshop, agriculture implements shade, Seed holding facility, office and ablution block, security quarters, storage rooms and emergency first aid quarters. (**Figure 5**). The water will be sources from the Zambezi River by using a new design of pump station floating raft to submersible pumps.

Figure 5 : Example of a submissible water abstraction from the river.

The river level in the Zambezi extremely high during the peak of summer around April / May. Hence river depth and bottom profile should be constantly monitored. An in-river survey will therefore be required once the river level has dropped in order to determine the actual water depth during the dry season. The low water level has to be inspected and found that the float stops on the edge of the water during the dry season. An additional end structure will therefore be required to extend the float into the river for another 5-10m in order to ensure adequate water level during the low season (July to November). Hence a floating jetty maybe a solution access the pumps and hold the transfer pipelines and power cable.

2.7.2. Availability of Services

NORED power is available within the near vicinity of the Project area as well as the proposed pump station site. The design will require power on the irrigation fields as there is to automate the mechanised irrigation infrastructure. Thus a distribution network will therefore be required to incorporate night irrigation. The main meter point will therefore be located at the at the connection from the river pump.

2.7.3. Proposed new Infrastructure River Pump Station (RPS)

The floating jetty structure will be essential to access the pumps and hold the pipelines and power cables. The structure will require to extend the pump during the dry season inside the river. Pumps will work on a two wet,one dry basis and operate on a cycled system. A cycled system rotates the dry pumpkeeping all three pumps in operation but still allowing the spare capacity if one unit fails. Submersible pumps have been selected due to high efficiency, simple maintenance andability to operate independently to river level. Any other pump system will either have tobe adjusted as the river level fluctuates or constructed on a floating platform.

Power Distribution

The current irrigation design will require power for both automated irrigation and that at the river pump station. A single meter will therefore be required from NORED at the RPS. The existing 11KV power line runs within 1km of the proposed site from the sub station. Despite the existing power line, an investigation of utilising Solar PV system should be considered and be a separate EIA.

Irrigation Fields

The initial irrigation fields are detailed in the design document. The layout comprises of 1000 ha in size. In order to ensure adequate management of water resources, each 50 ha zone within the 1000 hectare will be installed with an irrigation water meter on control point. A cost per cubic meter of water including all electricity, maintenance and depreciation costs will have to be determined and this will be used to asses the profitability of the crop yield.

2.7. Details of the proposed new infrastructure

The Tulela Agriculture Liselo Maize Irrigation Farm project will consist of the following structures:

- **Pumps and Controls**

Pumps Controls will be located in close vicinity of the pump but on higher lying ground. The pumps will be powered using grid or other power substitute..

2.8.1. Bulk Transfer Pipeline

The Bulk Transfer Pipeline runs from the RPS across the B6 bitumen road below through the culvert and delivers water to field edge via a uPVC 355mm class 9 pipeline. A series of air valves will be included on specified high points for vacuum and air removal.

A road crossing at B6 national road detail has been included which will be used to apply for the road crossing permit from the local authority prior to the construction of this portion of the pipeline.

The pipeline route has been designed to avoid any dwellings but will run through some dryland fields. Once installed, the fields can once again be utilized without any risk to the pipeline. The Liselo community has been informed of this and has agreed to this approach during the EIA information sharing session on the 14th April..

2.8.2. Pipeline Distribution Network

The Main pipeline branches off into the distribution pipelines at a reinforced concrete manhole located on the edge of the Liselo irrigation fields. The manhole will house non- return valves as well as the main shut off valves to each lateral line allowing individual shut off of each section for maintenance purposes. Each non-return valve will be fitted with bypass valves in order to bleed or drain the system.

2.8.3. On-Field Irrigation System

- **Irrigation Equipment**

A dragline system will be installed on each section plot comprising of the following:

- 63mm Galvanised Steel Control Point Water meter, pressure control vale, air-valve & fustigation valves.
- Central uPVC manifold pipeline of 63mm and 50mm.
- 9 x Aluminium irrigation hydromantic valves.
- 9 x Dragline Hose/Stand/Sprinkler Assembly.
- 9x Brass (or Plastic alternative) full circle impact sprinkler delivering 1.32 m3/hr at 25m pressure.

- **Design Irrigation Scheduling**

Each plot comprises of 8 sprinkler positions. The soils allow for a two-day irrigation cycle thus 4 positions are to be irrigated every 8 hours. This will also allow two families to utilize one plot. The plot can effectively be divided into two 0.5ha units

both utilizing the same dragline system irrigating on alternating days. The system delivers 24 mm per 12 hrs resulting in a gross application rate of 12mm per day.

2.8. Construction activities

All components for the irrigation construction will be transported to site by road on low- bed trailers and small trucks. Materials and equipment required will be transported from via Windhoek (from South Africa and/or Walvis Bay along the Windhoek- Okahandja-Swakopmund main road (i.e. the B1 and B2 then the Trans Caprivi Highway to Zambezi Region as well as other district roads to the Liselo area. No significant impacts associated with traffic interruption are expected on these roads.

Contractor camp sites of approximately 250 m^2 by 300 m^2 are normally made along at project sites. The sites for such camps forms part of the ongoing work. It is believed that the construction team for the irrigation project will be able to use the existing road trails available in the vicinity of the project site. Only smaller access tracks will be needed in isolated cases.

2.9. Maintenance activities

Pump stations and water pipelines require maintenance. Obvious accidents such as leakages, lightning strikes or towers blown over by exceptionally strong winds will be repaired by using the access roads (servitudes) which will be created during the construction process.

2.10. Potential key socio-economic and biophysical impacts associated with theconstruction, operation and maintenance of the proposed project

- Increase in employment opportunities
- Cumulative visual impact
- Nuisance and disrespect towards farmers/community
- Land disturbance
- Water quality pollution potential
- Loss of biodiversity and ecosystem services
- Surface drainage diversion, with associated erosion

- Air and noise pollution
- Flooding risks
- Pollution to groundwater aquifer
- Waste discharge
- Oil/fuel spillage
- Salinalisation
- Reduced runoff

2.11. Concluding remark on this section

In this section information on the rationale for the project, project location, project activities, and maintenance activities and structural requirements for the proposed Tulela Agriculture Liselo Maize Irrigation Farm are described.

3. SECTION 3: LEGAL AND REGULATORY FRAMEWORK REVIEW

The procedure of an Environmental Assessment prescribes the review of applicable And relevant legislation, which serves to inform the developer of the legal requirements and permit applications to be fulfilled before operation of the proposed development commences. The Environmental Expert has studied the national policy and legislative framework as well as international conventions governing the activities of this project. These applicable policies, laws and conventions, and their implications for this project are summarised below:

3.1 Legal instruments relevant to this project

There are various legal instruments that advocates for the effects of the proposed project on the receiving environment. Table 3 below shows the summaries of the legislation that are relevant to this project:

Table 3: Legal instruments relevant to this project

Topic	Legislation	Provisions	Regulatory Authority
Ecosystems maintenance and utilization of living resources	Constitution of the Republic of Namibia	The Constitution of the Republic of Namibia is the supreme law of the country and all legislation, including environmental laws must comply with it. Article 95(1), stipulates that: "The state shall actively promote and maintain the welfare of the people by adopting policies aimed at, the maintenance of ecosystems, essential ecological processes and biological diversity of Namibia and utilisation of living natural resources on a sustainable basis for the benefit of all Namibians, both present and future".	The Government of Namibia
Marketing of agricultural produces	Namibian agriculture marketing and trade policy and strategy 2011	This policy and strategy paper focuses on domestic marketing and trade within the agricultural and agro-industrial sectors. The Agriculture Marketing and Trade Policy and Strategy is developed with the aim of contributing to the achievement of the agriculture sector's objectives as reflected in Vision 2030, NDP4 and the National Agriculture Policy in concert with other policies and strategies across the agricultural value chain	Ministry of Agriculture Water and Forestry
Food and nutrition	Food and Nutrition Guideline for Namibiaof 2000	The essential role of nutrition in the promotion and enhancement of the overall quality and span of life is widely and well recognized. However, many Namibians suffer from nutritional disorders that are due to an inadequate food intake, both in terms of quality and quantity. These nutrition problems are related to diets, which are monotonous, deficient in food energy and contain few foods that are rich in vitamins and	National Food Security andNutrition Council

Topic	Legislation	Provisions	Regulatory Authority
Agriculture		minerals. The 'Food and Nutrition Guidelines' contained here are statements of advice to the general population about healthy food choices. If this advice regarding diet in general is followed, then diet will contribute to a healthy lifestyle, which in turn helps to reduce the risk of developing any of the various diet-related diseases. The guidelines aim to help people to develop and practice healthy eating habits. They are based upon current scientific knowledge and the best public health advice available at present. They contain up-to-date data on the relationship between diet and disease, nutrients available in the Namibian food supply, dietary habits, and the profile of morbidity and mortality in Namibia	
Green Scheme	Namibia agriculture policy 2015	This Policy provides a clear framework for all stakeholders in the Namibian agricultural sector to devise interventions that would enable them to make a concerted and meaningful contribution towards the sustainable development and growth of the agriculture sector in Namibia." As such, this Policy takes due cognisance of the relevant provisions of World Trade Organisation (WTO) Agreement, the Southern African Development Community (SADC) Protocol on Trade, the Southern African Customs Union Agreement (SACU) Agreement, the Dar es Salaam Declaration of Agriculture on Food Security, the revived SADC Regional Indicative Strategic Development Plan (RISDP), the 2003 Comprehensive Africa Agriculture Development Programme (CAADP) and the 2014 AU Malabo Declaration, amongst others. the Namibia Agriculture Policy is aimed at contributing to increased agricultural production, agro-processing and marketing as well as to serve as an overarching policy in the agricultural sector	Ministry of Agriculture Water and Forestry
	Green Scheme Policy of 2008	**One of the objectives of this policy to be achieved through the following:** ▪ Increasing the existing irrigated agricultural areas to full potential; ▪ Identification of potential areas for agricultural irrigation; ▪ Development of agro-projects at identified areas for irrigation; and ▪ Promotion of the efficient utilization of agricultural land and water resources;	Ministry of Agriculture Water and Forestry

Topic	Legislation	Provisions	Regulatory Authority
Drought	National drought policy & strategy of 1997	Some objectives of the new drought policy are to relevant to the Tulela Agriculture Liselo Maize Irrigation Farm are: ▪ Ensure that household food security is not compromised by drought; ▪ Encourage and support farmers to adopt self-reliant approaches to drought risk;	Ministry of Agriculture Water and Forestry
Environmental Impact Assessment	Environmental Management Act of 2007 and EIA regulation of 2012	Provides a list of activities that require an environmental assessment, including: Electrification. The Act also provides procedures for adequate public participation during the environmental assessmentprocess for the interested and affectedparties to voice and register their opinions and concerns about proposed projects.	Ministry of Environment and Tourism
Water Supply and Effluent Discharge	Water Resources Management Act 2013	This Act provides provisions for the control, conservation and use of water for domestic, agricultural, urban and industrial purposes. The Act states that a license or permit is required to abstract and use water, and also discharge effluent. Effluent (i.e. Human Waste) from the mobile toilet will be discharge at the Rundu Town Council Sewerage System. Permission willbe required from the facility owner prior to the dumping of the sewage. No effluent will be discharge in any watercourse. Waste water from dust suppression will be minimal and the water is expected to evaporate fasterthan it infiltrates. Therefore, no effluent discharge permits will be required for thisproject However, since this a community irrigation project, a water abstraction permit will be required and should be applied for by the Proponent to the Ministry of Agriculture Water and Forestry.	Ministry of Agriculture Water and Forestry

Topic	Legislation	Provisions	Regulatory Authority
Hazardous Substance such as used oil which (e.g. diesel)	Hazardous Substance Ordinance 14 of 1974	The Act provides for the control of substances which may cause injury or ill-health to or death of human beings by virtue of their toxic, corrosive, irritant, strongly sensitizing or flammable nature or the generation of pressure thereby in certain circumstances; to provide for the prohibition and control of the importation, sale, use, operation, application, modification, disposal or dumping of such substance; and to provide for matters connected therewith"	Ministry of Health and Social Services
Fauna and flora	The Nature Conservation Ordinance, Ordinance of 1975,	In the course of the project activities, care must be taken to ensure that protected trees, species and the eggs of protected and game bird species are not disturbed or destroyed. If such destruction or disturbance is inevitable, a permit must be obtained in this regard from the Minister of Environment.	Ministry of Environment andTourism

Topic	Legislation	Provisions	Regulatory Authority
Used oil	Petroleum Productsand Energy Act 13 of 1990	The Act provides provisions for any certificate holder or other person in control ofactivities related to any petroleum product is obliged to report any major petroleum product spill (defined as a spill of more than 200ℓ per spill) to the Minister. Such person is also obliged to take all steps as may be necessary in accordance with good petroleum industry practices to clean up the spill. Should this obligation not be met, the Minister is empowered to take steps to clean up the spill and to recover the costs thereof from the person. Used oil from this projectwill be disposed at the Walvis Bay Municipality Hazardous Waste Site. Permission will be required from the facility owner prior to the dumping of the used oil.	Ministry of Mines and Energy
Employees	The Labour Act, 2007 (Act No. 11 of 2007)	The Labour Act gives effect to the constitutional commitment of Article 95 (11), to promote and maintain the welfare of the people. This Act is aimed at establishing a comprehensive labour law for all employees; to entrench fundamental labour rights and protections; to regulate basic terms and conditions of employment; to ensure the health, safety and welfare of employees	Ministry of Labour and social welfare
Archaeological sites	National Heritage Act 27 of 2004 Ministry of Youth	This Act provides provisions for the protection and conservation of places and objects of heritage significance and the registration of such places and objects. The proposed project will ensure that if any archaeological or paleontological objects, as described in the Act, are found in the course of its construction, and operations that such findings be reported to the Ministry immediately. If necessary, the relevant permits must be obtained before disturbingor destroying any heritage.	National Service, Sport and Culture
Desertification	United Nation Convention to Combat Desertification 1992	The convention objective is to forge a global partnership to reverse and prevent desertification/land degradation and to mitigate the effects of drought in affected areas in order to support poverty reduction and environmental sustainability	United Nation Convention

Topic	Legislation	Provisions	Regulatory Authority
Biodiversity	Convention on Biological Diversity (CBD) 1992	This convention advocates for the conservation of biological diversity, the sustainable use of its components and the fair and equitable sharing of the benefits arising out of the utilization of genetic resources.	United Nation Convention
Field and forest fire	National Veld and Forest Fire Act 101 of 1998	The aim of the National Field and Forest Fire Act 101 of 1998 is to prevent and combat field, forest and mountain fires and to providefor a variety of institutions, methods and practises for achieving this purpose. The client must familiarise himself with this Act, since lightning to power-lines may cause field fires.	Ministry of Agriculture Water and Forestry
Removal of trees and vegetation	The Forest Act (Act 12 of 2001),	The Forest Act (Act 12 of 2001), stipulates that a permit should be obtained from the Ministry of Agriculture Water and Forestry for the removal of vegetation within 100m from a riverbed. This act also protects certain plant species. For this project site, minimal trees species are available and these trees won't be remove, but will be used for shelter.	Ministry of Agriculture Water and Forestry

3.2 Regulatory authorities and permitting

The environmental regulatory authorities responsible for environmental protection and management of various aspects relating to activities of this project including their role in regulating environmental protection are listed in **Table 4** , below shows an extract from the legal instruments of the regulating authorities with respect to the relevant permits/ licenses required for the proposed project.

Table 4: The regulatory authority and permitting

Activities list	Applicable Legislation	Permitting Authority	Current Status
EIA and EMP Clearance Certificate	Environmental Policy and Environmental Management Act, (Act No. 7 of 2007)	Ministry of Environment and Tourism (MET)	To be applied for on completion of this EIA and EMP Report for Implementation stage of the project
Abstraction of water for irrigation purposes	Water Resources Management Act, 2004 (No. 284 of 2004).	Ministry of Agriculture, Water and Forestry	To apply priori to commencement of the project
Removal, disturbances or destruction of bird eggs	Nature Conservation Ordinance 4, 1975.	Nature Conservation Ordinance 4, 1975.	To apply when Required
Removal, destruction of indigenous trees, bushes or plants within 100 yards of stream or watercourse	Forestry Act, 12 of 2001	Ministry of Water Affairs and Forestry (MWAF)	
Discarding or disposing of used oil	Petroleum Products and Energy Act 13 of 1990	Ministry of Mines and Energy (MME).	
Construction of waste Disposal sites.	Environmental Policy and Environmental Management Act, (Act No. 7 of 2007)	Ministry of Environment andTourism (MET)	
Magazines for Blasting	April 1978),	consultation with Ministry of Mines and Energy (MME).	

3.3 Concluding remark on this section

In this section information on the relevant legislation to the project, the type of licenses required and the permits are presented. The regulatory authorities relevant to the projectare also mentioned in this section.

4. SECTION 4: RECEIVING ENVIRONMENT

4.1 General description of the project

The proposed Tulela Liselo irrigation maize project (Fig 6), will involve the installation of a submissible pump station at Winela to abstract water from the Zambezi River, a 3km long PVC pipeline, and an initial 1000ha irrigation field of the total 5000 ha allocation. As mentioned earlier, this project will take place at the Liselo settlement in Zambezi Region.

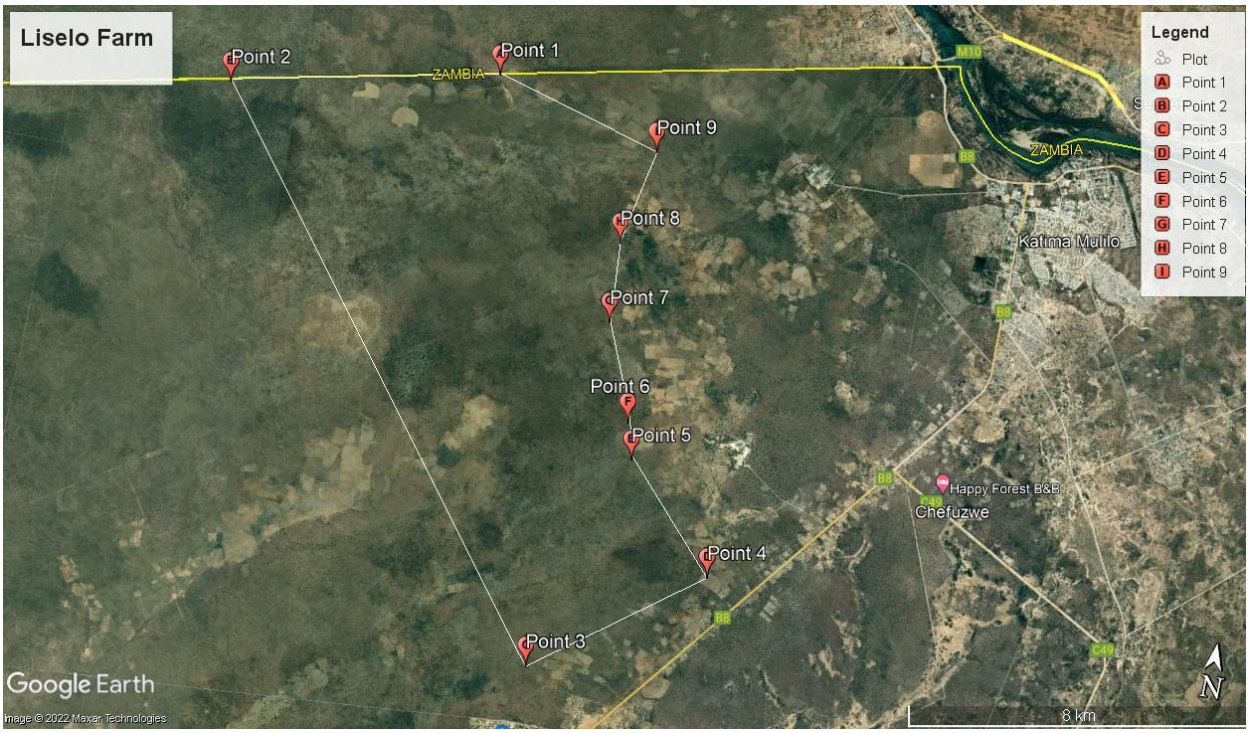

Figure 6 , Tulela Liselo irrigation agriculture project at Liselo, Zambezi Region.

4.2 Socio-economic environment

The Liselo community like most of the communities in Zambezi region, cultivate dryland plots as well as small gardens around their homesteads. Hence surviving on subsistence farming. The 5000 hectares designated area for Tulela Liselo irrigation agriculture project comprise of land that has been inherited by the Liselo community for subsistence farming. As evidenced by the constitution the Liselo Traditional Khuta on behalf of its community members (Fig 7), have agreed to

lease the 5000 hectares for the Tulela Liselo irrigation agriculture project, in the hope that they will benefit from the project.

During stakeholder consultations it was established that, about half of the household lands are ploughed through hire of the government tractor that is available. Some 40%of the households own cattle and use oxen for ploughing and among those with no cattle there is some exchange of labour for use of oxen.

Figure 7 , Liselo community members during stakeholder consultations on 14th April 2022**.**

Some households have no money or livestock and resort to hand tillage. The maize crop, which most reliably gives a yield but this is intercropped to varying degrees with small amounts of beans, groundnuts, pumpkin, watermelon, sorghum

(sweet reed), and sweet potato. Fertilisation is generally done only through grazing of livestock on the land during the dry season. Crops are mostly hand weeded twice, and harvested by hand. Anaverage plot of 3 hectares produces some three tonnes of maize grain, which is consumed by a family of 6 or 7 people over some six months. For the remainder of the year an average family needs to buy in the shortfall staple maize grain. Sales of products from croplands are uncommon, only taking place where surpluses are produced, among those with the largest land holdings and in good rainfall years.

Some households own livestock (cattle and goats), which are grazed communally in the surrounding. All households harvest fuelwood, and nearly all harvest poles, thatch-grass, reeds, and wild plant foods and medicines. Coping mechanisms include finding local employment, and employment in Katima Mulilo. Local jobs include those in tourism lodges, churches, teaching, and cleaning. Local small and informal enterprises include shebeens, hairdressing, brick making, fat cake making/selling, craft making/selling, vegetable production, chicken production, and goat production. Much of the household cash requirements for buying food and paying school fees, among other needs, come from government grants, such as from pension and orphan grants. Remittances from employment are also important, as are income earned from small informal enterprises.

4.3 Aarchaeology

There are no recorded archaeological sites within 10 km of the project area (Mendelson, 2000). However, during excavation, if there will be any archaeology sites or materials willbe discovered this should be report to the National Heritage Council of Namibia.

4.4 Climate

The Zambezi Region (formerly Caprivi Strip) has a hot climate. Rain usually falls in the form of heavy thunderstorms. There is a Wet season, which coincides with the summer months of November to April. During the dry winter months, from May to October, there is virtually no rain at all and it gets very cold in the morning.

These are the coolest months and there is almost no rain at all. It gets drier as the winter progresses.

- ***May, June, July & August*** – It is usually sunny and totally dry. These are the coolest months and the average afternoon temperature is 27°C/80°F. It is cold in the early morning, around 8°C/47°F. Warm clothing for early morning wildlife drives is necessary.
- ***September & October*** – Temperatures are increasing. October is the hottest month with afternoon temperatures of 35°C/95°F and much higher peaks. Early mornings are less cold, around 15°C/59°F. The rains usually start towards the end of October or early November.

Wet season–***November to April – Summer***

The Wet season falls in the hot summer months but rainfall isn't very high. Afternoon thunderstorms can be expected on some days. It is mostly sunny and hot. Early mornings are mild.

- ***November & December*** – The rains usually start late October or early November. It is still mostly dry, but you can expect the occasional thundershower which brings relief from the long, dry winter. Afternoon temperatures are around 32°C/90°F.
- ***January, February & March*** – January and February are the wettest months. Afternoon thunderstorms are common, but it is mostly sunny during the day. It usually cools down after rain and average daytime temperatures are around 31°C/88°F.
- ***April*** – Rain decreases rapidly in April and there are less and less days with precipitation. Temperatures start to drop slowly.

4.5 Flora

Plant species are protected under two separate legal instruments, being the Forestry Act (Act 12 of 2001) as well as the Nature Conservation Ordinance (Ordinance 4 of 1975). Under the Forestry Act, a number of tree species are confirmed as declared protected species. These have been declared under the Forestry Ordinance of 1952 as well as Proclamation 486 of 1972 of the SWA Administration. Special permission is required by the Directorate of Forestry to remove these species. In addition to these specially protected species, permission is also needed from the Directorate of Forestry for general clearing of woody plants, as well as the transport of any such wood or wood products from the site / property it has been cleared from. These species include: Baikiaea plurijuga (Zambezi teak) Pterocarpus angolensis (African teak / kiaat) Afzelia quanzensis

(Pod mahogany) Dialium engleranum (Kalahari podberry) Guibourtia coleosperma (False mopane / rosewood) 4 Burkea africana (Burkea)

Majority of these plant species where identified during the construction phase of the power lines interconnection with Zambia in the area, and in Katima farm area.

Although , the vegetation in the Liselo Farm area is largely a combination of acacia, Terminalia and few of the small shrub. The unique feature here is the prominent presence of the savannah grassland, silver terminalia, acasia melifera and acasia vachellia tortillisa and few mopane species. There are no rivers or any perennial water bodies within the farm.

Figure 8, ***:*** *Acacia melifera & Silver terminalia in Liselo farm area*

4.6 Soil type in the Tulela Agriculture Liselo Maize Irrigation Farm

4.6.1 Soil Survey

The Community has been previously growing Maize on subsistence farming before in the Project Liselo farm area. From an initial desk study, it was evident that there are a number of different soil conditions in the project area that is a combination of sandy-loam soils.

4.6.2 Soil description

The land is on the flat area few kilometers from the perennial Zambezi river terrace, It is dominated by grey- sandy loam soil, of medium potential for sprinkler irrigation, which grade into sands on the southern northern part.The suitable soils are quite extensive and extend along the area previously that where small river channels in the farm area.

4.6.3 Soil moisture

Water infiltration in these soils is estimated to be about 50 mm/h or more, which means that most rain/irrigation would infiltrate the soil. This can result in leaching of nutrientsout of the root zone of the crop and must be considered in the irrigation design and irrigation scheduling for the soil. Runoff of water from these soils is only possible or likelywhen rain or irrigation exceeds the infiltration rate of the soil. The water holding capacity for this soil at field capacity is estimated to be about 70-150 mm/m depth of the soil with plant available water of between 30 to 100mm/m. These figures are based on and only relevant at the estimated clay content of between 4% and 10 %. Because the soil shows an increase in clay content with depth, it can be assumed that the average plant available water in the soil will be in the region of 60 to 70 mm/m. This means that the soil has a low water holding capacity compared to other soils, and will need to be considered when developing the water scheduling.

4.6.4 Drainage of the soil

The soil has good drainage, with no signs of a water table or periods of water logging in the soil.

4.6.5 Organic matter of the soil

The organic matter in the soil appears to be very low. With an increase of organic matter, the water holding capacity of the soil can be increased, resulting in numerous benefits. This can be achieved through the addition of manure and compost, and proper soil management over time.

4.7 Water Resources

4.7.1 Water quality

The available water analysis indicates very low sodium content with a SAR (Sodium Absorption Ratio) of lower than 10 mmol/dm^3 at 0.206 mmol/dm^3 - suitable for irrigation with a negligible salinity hazard and electric conductivity of lower than 25 mS/m at 4.2 mS/m. These means that the water from the Zambezi River presents no salinity hazardon well drained soils. The water can thus be classified as C1-S1 quality irrigation water, which indicates top quality water suitable for irrigation.

5.0 General surface water hydrology of the study area

In order to ascertain the risks involved with ground water vulnerability in relation to irrigation in Liselo area, CEGEOR undertook a desktop study to provide hydrogeological information of the proposed Tulela irrigation Liselo Maize Farm and its surroundings to contribute to a comprehensive environmental impact assessment (EIA). For this reason only those environmental aspects directly related to groundwater issues will be addressed as they relate to the health, the sociocultural and the natural environment. Zambezi Region has been known for its high rainfall and abundant surface water resources, however, from a groundwater point of view, the region has been a problem, this is more so as the distance from the perennial rivers/flood plains approach 10 Km. For this reason, In both campaigns, groundwater quality has been reported as the main problem, particularly high sodium and chlorides, and in some places high iron content presented problems to the suitability of groundwater for human consumption.

Centre for Geosciences Research under a desk top review assessment of the project area to ascertain the water levels and groundwater quality from existing boreholes as well as from hand dug wells. This was regarded important for environmental assessment, especially in establishing the baseline hydrogeological assessment of dynamic groundwater aspects using historical data from Ministry of Agriculture and Water Affairs. Hence CEGEOR cc compiled a desktop study. After reviewing existing information in the project area, it became clear that there is limited information in the confines of the study are, partly because the area is not inhabited by human beings.

The assessment also included literature on existing data and hydrogeological information as it relates to physiography, geology of the Kalahari Group, hydrodynamics, water quality, aquifer pollution vulnerability (APV) and groundwater environment.

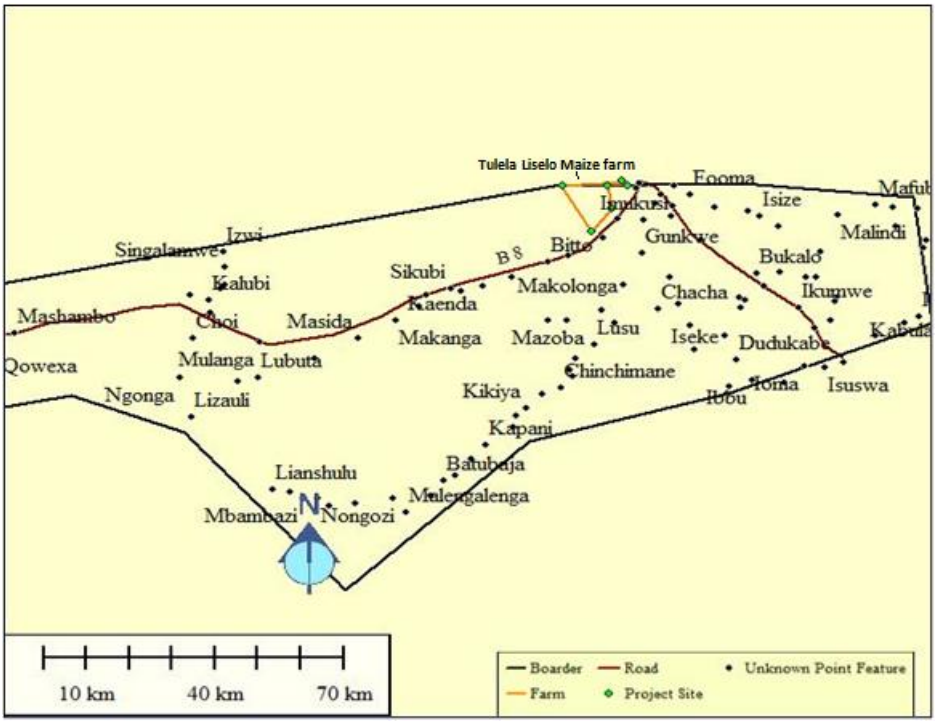

Figure 9, : Locality of the Tulela Agriculture Liselo maize project.

5.1 Physiography

The study area which is the proposed Irrigation Maize Farm is located in the first quadrant of 17°S and 24°E, comprising communally owned land in the Zambezi Region, whereas Katima Mulilo is located approximately 10 Km east of the study area (**Figure 9**).

From a relief point of view, the study area is essentially flat lying with an average elevation of 996 metres (Google Earth based estimate) above mean sea level. The area has a range of relief of approximately 58 m with a gentle regional slope towards the chobe River and 48 m eastward to Katima Mulilo. The highest elevation is at 1027 metres above mean sea level at approximately 50 Km west of the Farm. Tectonically, the farm is located on the northern edge of the Sibinda-Katima Mulilo Faulty (**Figure 2**), and is therefore on the elevated portion of the Zambezi Region.

5.2 Surface Drainage

From a drainage point of view, the farm is situated in the Zambezi River Catchment with surface water essentially flowing eastwards towards the Zambezi River (**Figure 10**). However, Mendelson (2002) indicates that the study area falls within the Cuabango catchment (**Figure 11**).

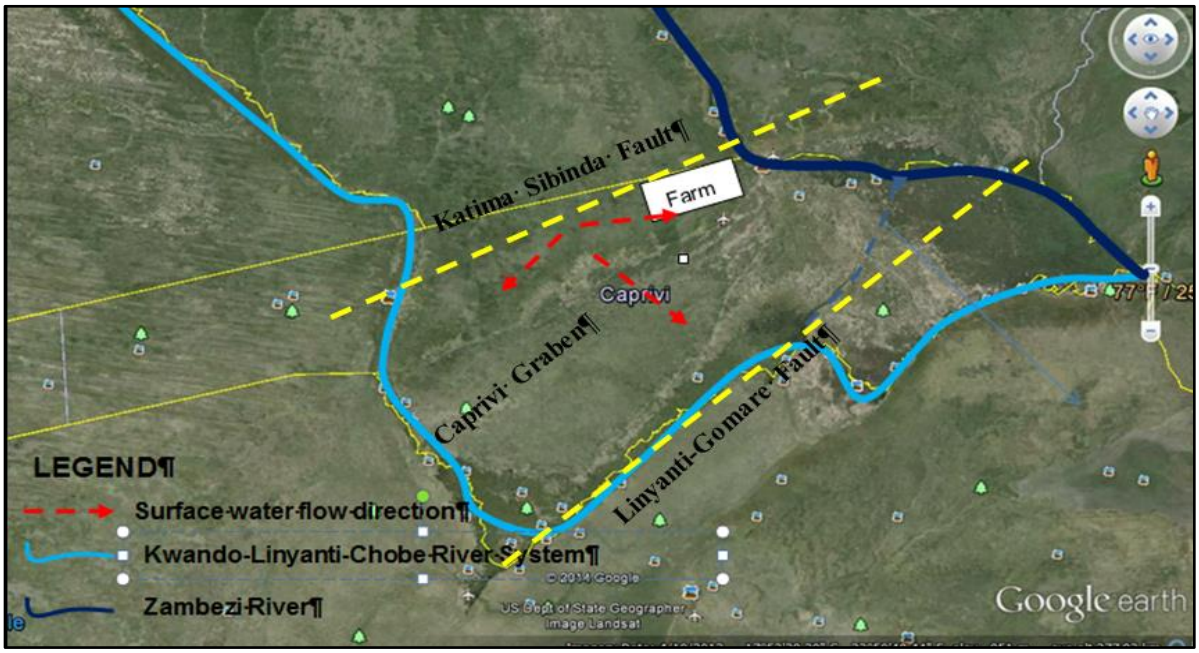

Figure 10, : The regional drainage system

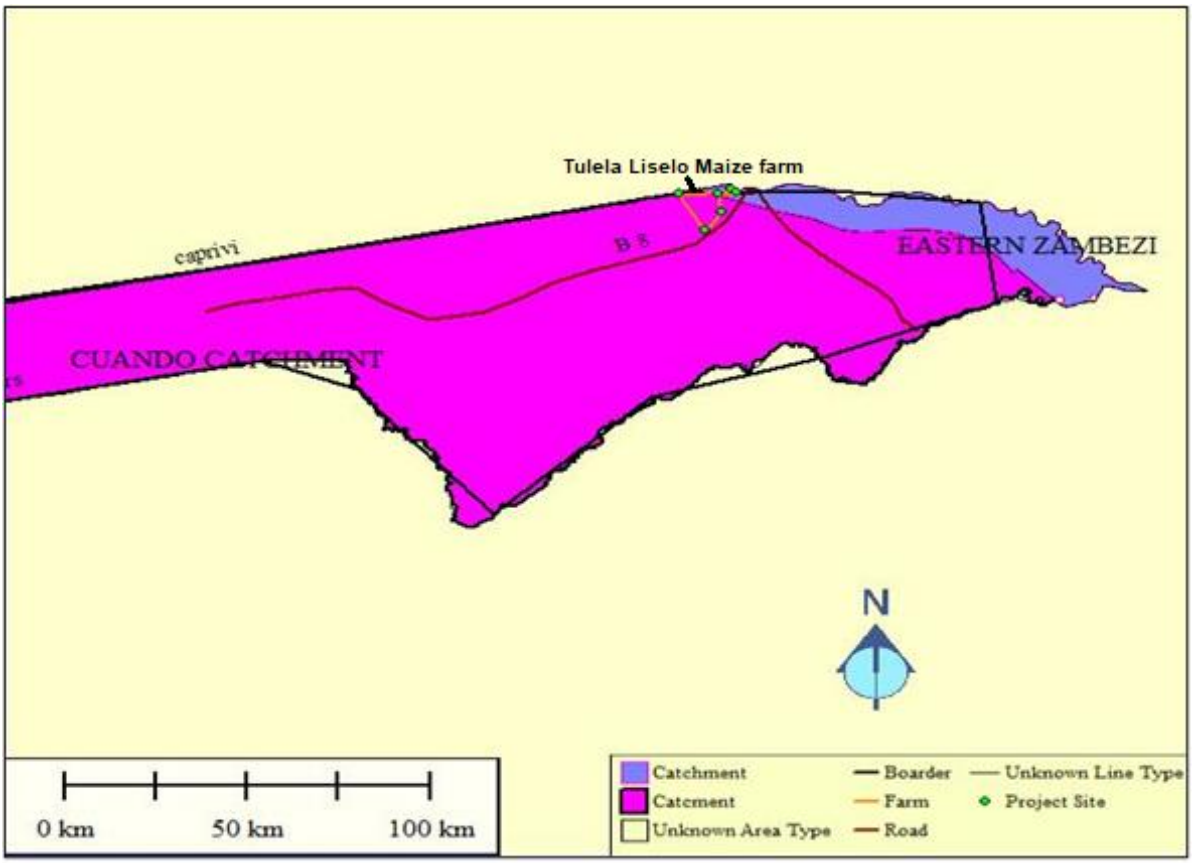

Figure 11, The catchment and adjacent catchments in the proximity of the Tulela Agriculture irrigation maize farm.

5.3 Geology

According to Miller (2008), a large part of the central Zambezi Region is underlain by the deep seated relatively low–lying, post Karoo, NE-trending Caprivi Graben (**Figure 10**). For this reason, the broad Kalahari stratigraphic succession of the region only applies to the Zambezi Region.

Broadly, the stratigraphy of the Kalahari Group in the Zambezi region comprises of three layers (**Table 1**), namely the upper layer which is predominantly consists of brown, fine grained sand. This layer attains a thickness of about 107 m in the Sibinda Area, but progressively thins out to thickness of about 50 m at around Bito and thereafter it maintains that thickness. The second layer is thin (12 to 26 m) and is predominantly clay, whereas the third layer consists of coarse grained sand and host fresh water. **Table 5** present the idealized stratigraphy of the Kalahari Group as it pertains to the Zambezi Region, thereafter, Karoo Basalts are known to underlay the Kalahari Sediment and out crop in several places of the region (Based on Miller, 2008), i.e. Ngoma, Impalila Island and along the bank of the Zambezi River west of Katima Mulilo.

Table 5: Summary of the stratigraphy and hydrostratigraphy of the Kalahari Group in the Zambezi Region

GROUP	FORMATION/SUB-UNITY	SEDIMENT DESCRIPTION	HYDROSTRATIGRAPHY
KALAHARI	Upper Layer	Brown fine sand and calyey sand	Potable groundwater up to about 70 m deep, then becomes saline up to the clay layer at the depth of about 107 m
	Clay marker layer	Green and greenish Clay	12 to 26 m of clay
	Lower Layer	Green medium grained sand	Medium grained sand potable water aquifer which seems to be feed from the Kwando River, but becomes saline towards the Linyanti River
Karoo	?	Karoo Basalt	?

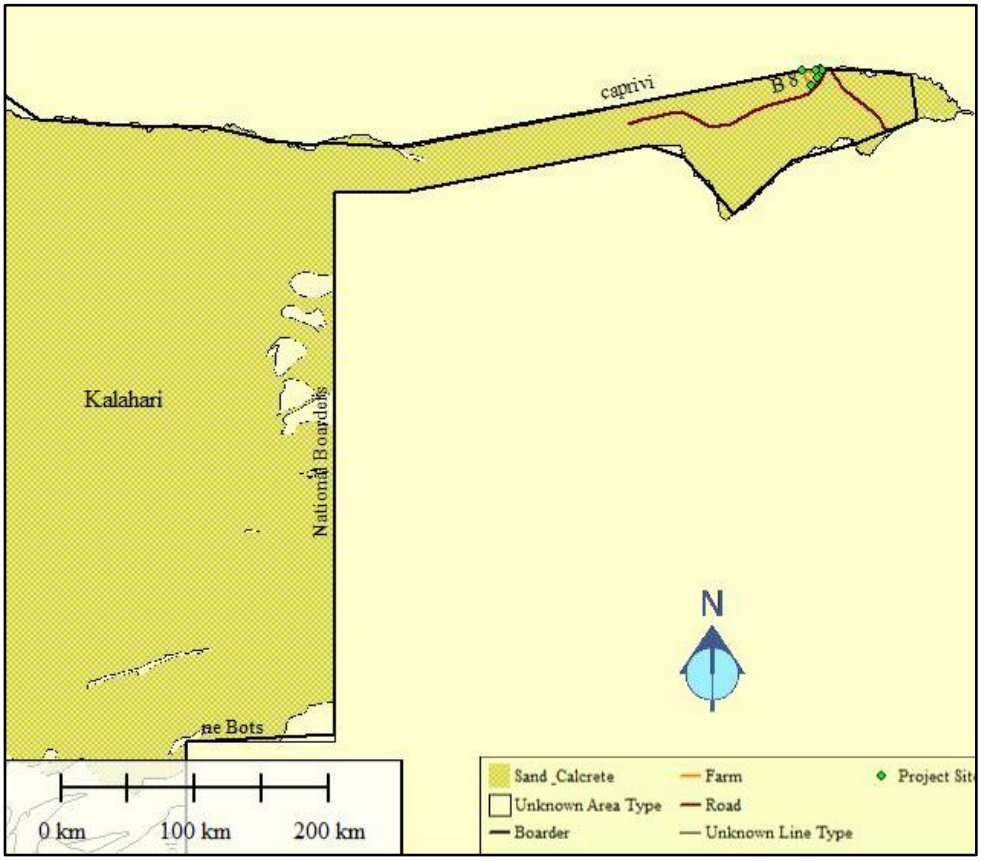

Figure 12 The geology of the (Caprivi) Zambezi region

5.4 Hydrogeology

The hydrogeological unity within which the project site is located as indicated by the hydrogeological map of Namibia (Department of Water Affairs [**DWA], 2003**) is classified as a productive porous aquifer (**Figure 13)**. Therefore, the Kalahari Aquifer in the Zambezi region has the capacity to meet local water supply demand if appropriate techniques to seal off saline water layers are sourced and correctly applied.

Fresh groundwater occurrence in the region is often associated with coarse grained fluvial sediments in the upper layer as well as in the lower layer, particularly where these layers attains a thicknesses of more than 60 m.

According to the 1990 groundwater survey (Interconsult, 1990), from the average borehole yield point of view, the groundwater potential of the area improves eastwards from the project Area towards the Zambezi River, whereas the groundwater quality improves westwards towards the Kwando River and deteriorates southwards towards lake-Lyambezi.

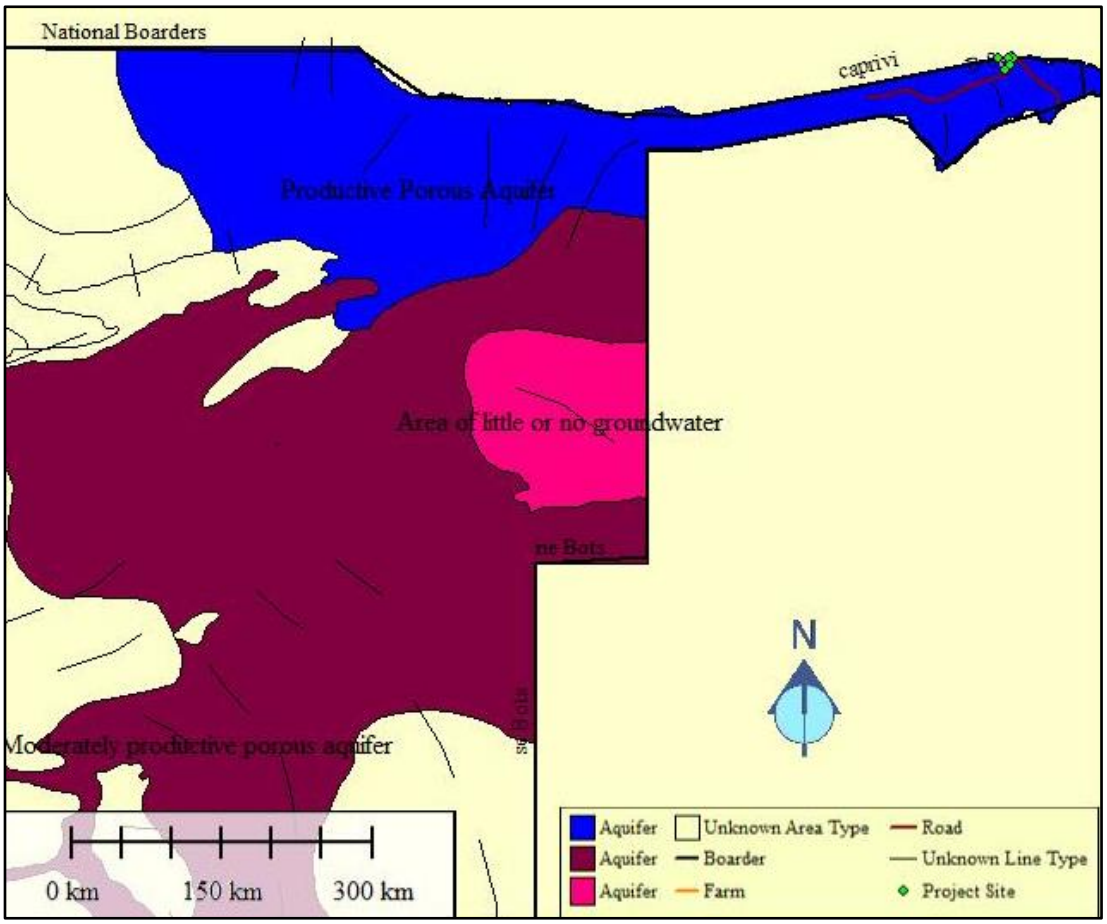

Figure 13 :Aquifer productivity of the Kalahari Aquifer

A review of the depth to the water table from the National Data Base indicates that economically viable good quality groundwater resources in the upper layer are confined to the maximum depth of 62 m (**Figure 14**). Besides the relatively high sodium content of the local groundwater in the project area, the hydrogeological setting is favourable for locals to exploit groundwater.

With regard to the regional piezometry, estimates from topographic height, Interconsult (1990) indicates that groundwater flow appears to be essentially from the southwest to the northeast, and is largely controlled by Caprivi Graben. Towards the rivers, the piezometric gradients are reportedly steep, trending away from the surface water and with isolines running approximately parallel to the rivers. Therefore, all rivers are influent with respect groundwater.

With reference to the morphology of the groundwater table, the proposed Maize farm lies on a local groundwater high which runs linearly from Makundu and Sibinda towards Liselo- Mpacha (Interconsult, 1990). This groundwater high is related to elevated clay marker layer which is reportedly upward inclining in the northeast direction (**Figure 15**).

Due to the unconfined nature of the upper aquifer, the high rainfall regime of the area, the shallow water table and the poor run-off characteristic of the region, potential recharge throughout the region is expected to be high. This is expected to be further enhanced by induced recharge from over flowing perennial rivers, particularly during flood seasons. This inference tallies with the observed dominant calcium bicarbonate hydrochemical facies in most groundwater quality analyses (Interconsult, 1990). It should be noted here that the well at Liselo is an exception to the above finding, because it exhibits sodium-sulphate-chloride hydrochemical facie.

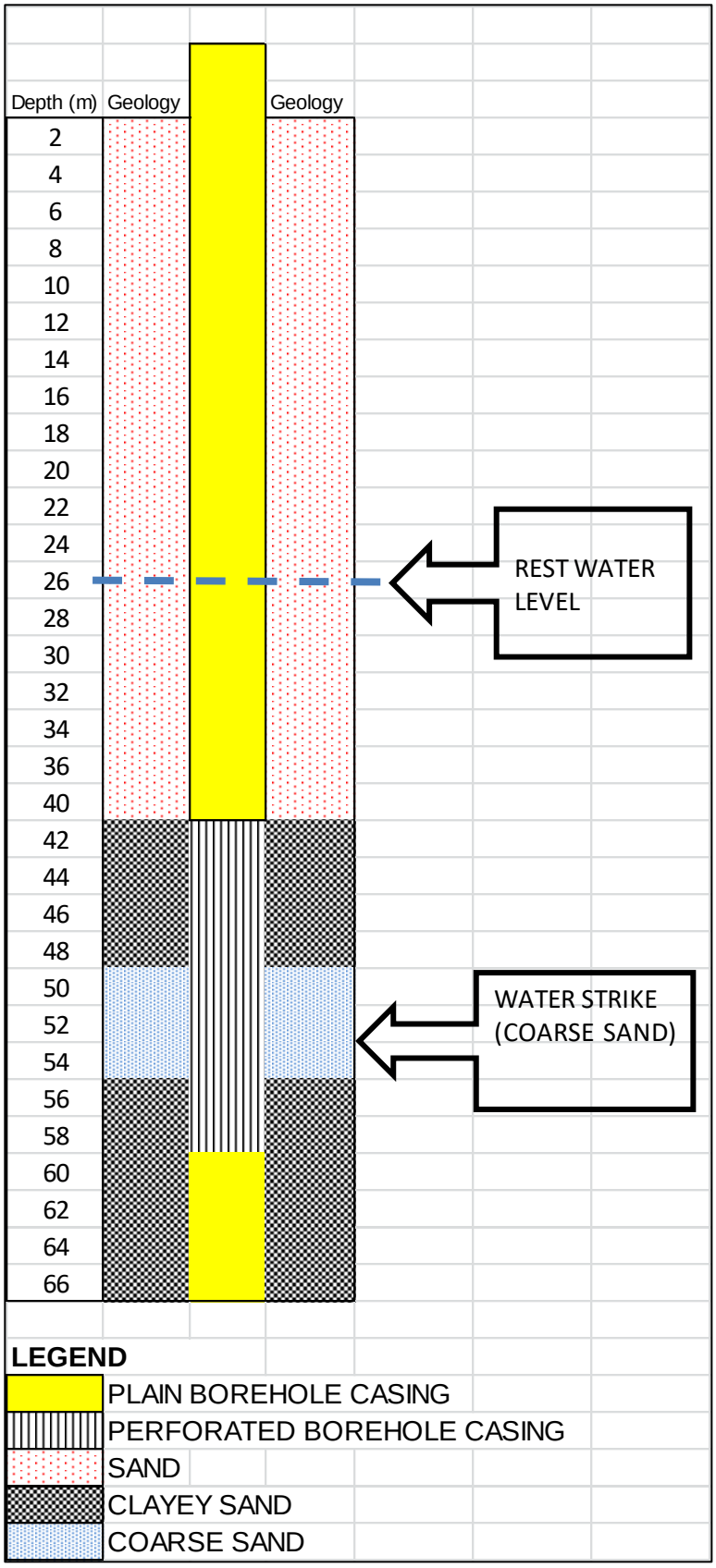

Figure 14: Borehole ID 39109 on the Liselo Maize farm

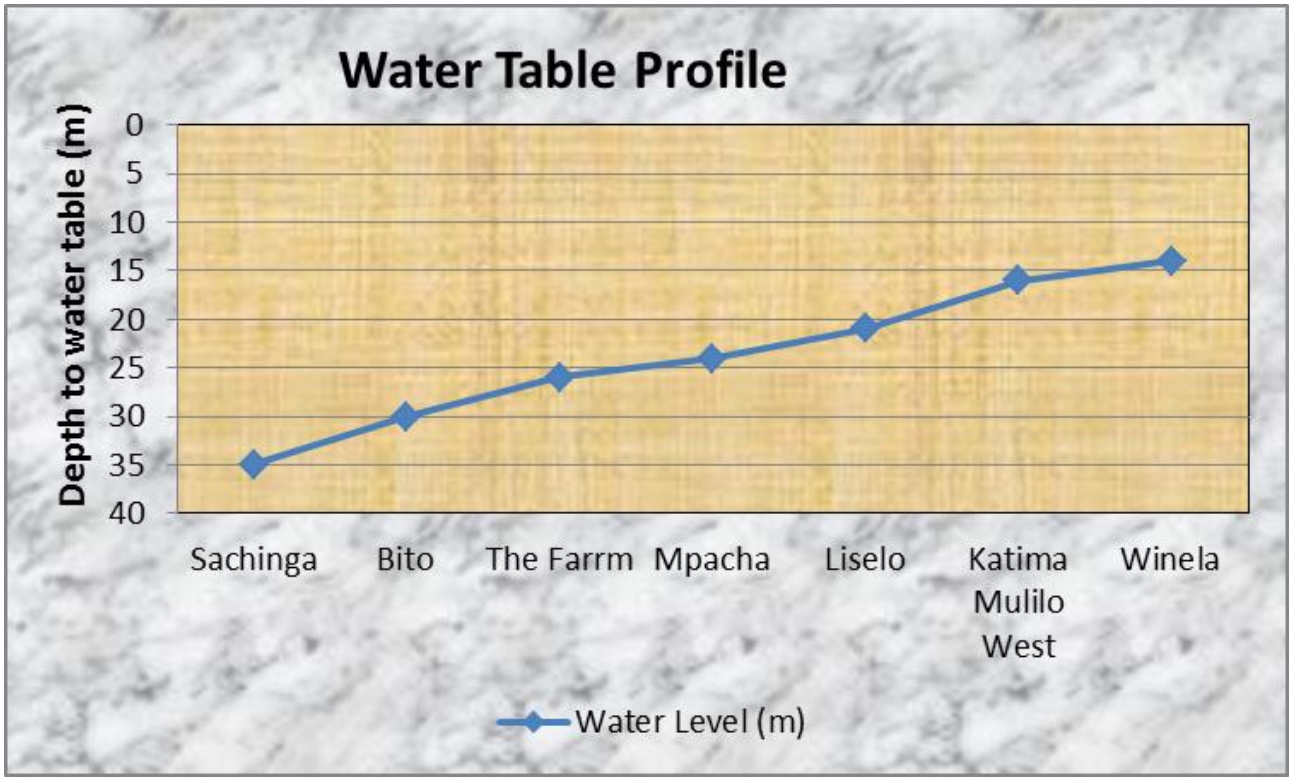

Figure 15: The water table in the north eastern direction towards the Zambezi River

5.4.1 Water Quality

During the 1990 groundwater survey, water samples were collected and analysed for standard chemical components or determinants (**Table 3**)

***Suitability for chemical quality of drinking water*:** B, good for human consumption

Stock watering: Suitable

Irrigation Classification: C2-S2, medium salinity is suitable for plants with moderate salt tolerance provided a moderate leaching of salts from the soil occurs.

Medium Sodium content: Suitable for coarse-textured or organic soil with good permeability, hazardous to fine-textured soils with high cation-exchange capability unless gypsum is present.

Salinity of water with respect to CaCO3:

- Langelier Index = -2.3, aggressive.
- ***Ryznar Index*** = 11.1, aggressive.
- ***Corrosion of water towards steel***: Corrosivity Ratio = 3.3, corrosive.

Table 6: Chemical analyses of the groundwater from the Liselo Well approximately 2 km south of the proposed farm

Determinant (mg/l)	**Liselo** (well)	**Group**
pH	6.5	A
EC (mS/m)	48	A
Sodium	108	B
Potassium	12	A
Calcium	18	A
Magnesium	4	A
Hardness T	22	A
Alkalinity T	66	
Chloride	80	A
Sulphate	100	A
Nitrate	0.9	A
Fluoride	0.2	A
Silica	31	
Classification		**B**

A generic evolution of groundwater chemistry usually begins with a calcium bicarbonate hydrochemical facie ($Ca(HCO_3)_2$) in the recharge zone of an aquifer, as the groundwater becomes older along the flow line, it slowly precipitates calcium and the chemistry dominantly becomes sodium bicarbonate in nature. The area at which groundwater loses the all its bicarbonates to adapt a completely sodium chloride chemical signature is called the Calcrete-Line, therefore beyond this point along the flow line no calcrete develops (**Figure 6**).

In view of the hydrochemistry of the study area , the Tulela irrigation Maize farm area is situated beyond the calcrete-Line and from the theory of the evolution of groundwater chemistry, the groundwater within the study area should have an insignificant recharge component. This theoretical expectation together with the hydrochemistry of the study area is in sharp contrast with or is special case outside Interconsult (1990)'s general statement that the Zambezi Region has a high recharge potential.

In the absence of any evidence contrary to this observation, the aquifer pollution vulnerable of the study area needs to be reviewed and re-qualified.

The above observation – the sodium chloride hydrochemical facie, postulates that the groundwater in the study area is largely static. This inference tallies with the Piper Diagram plot of the Liselo Well plotting on the line between static and dynamic groundwater but more towards the right and not towards the side of the broken red line (**Figure 16)**

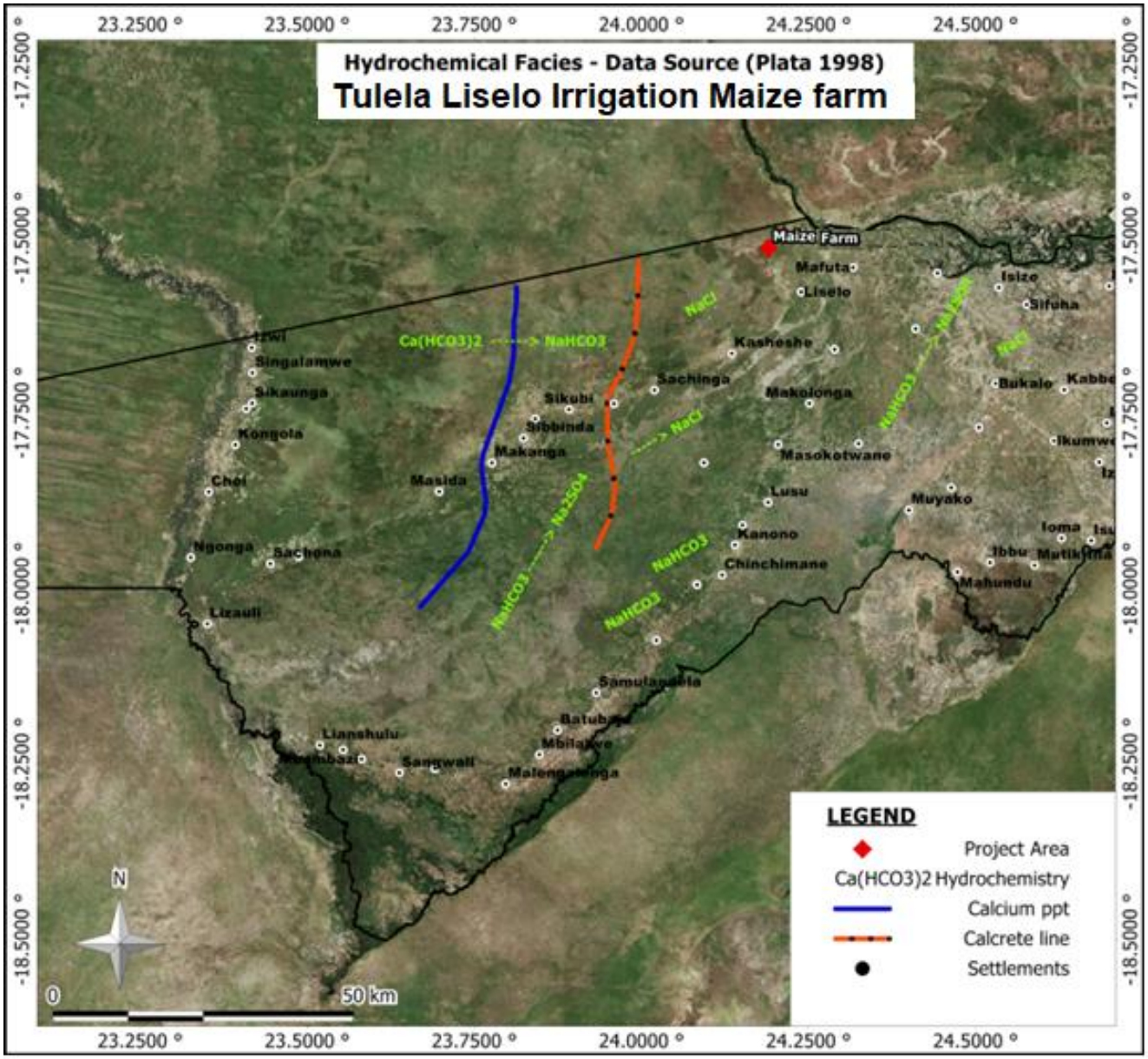

Figure 16 :Shows the hydrochemical evolution along the flow line covering Liselo area.

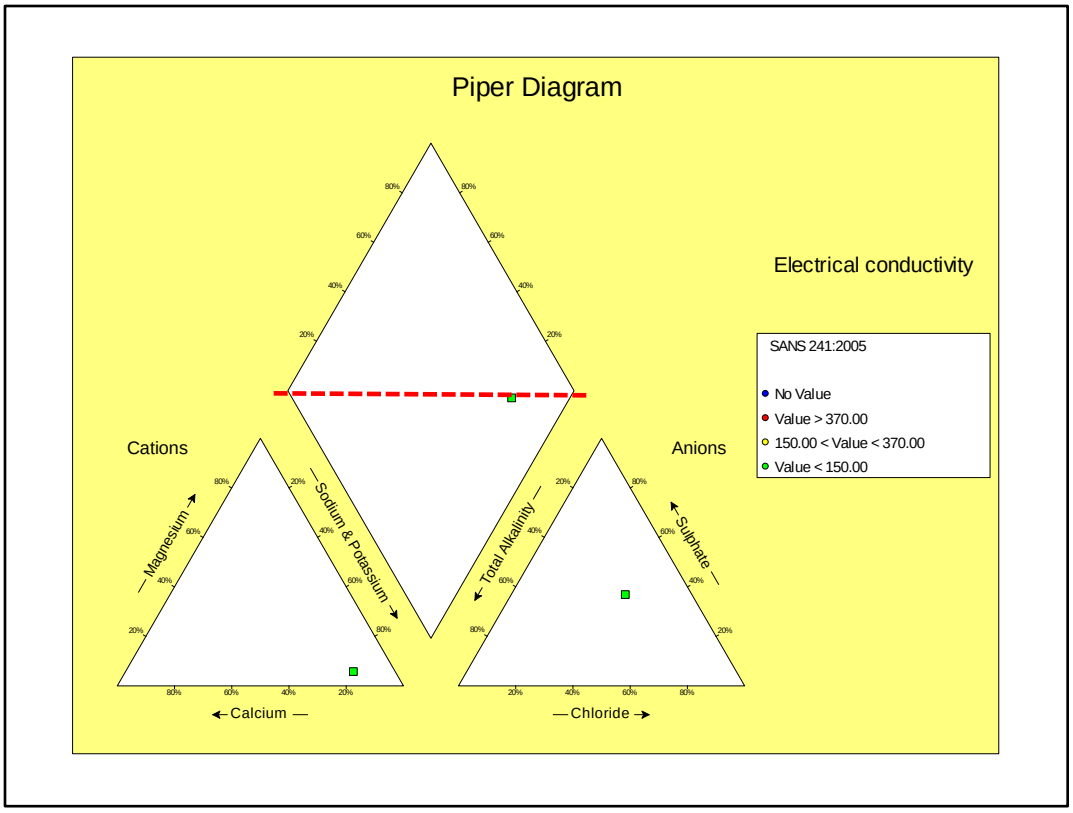

Figure 17: The Piper Diagram of the Liselo Well

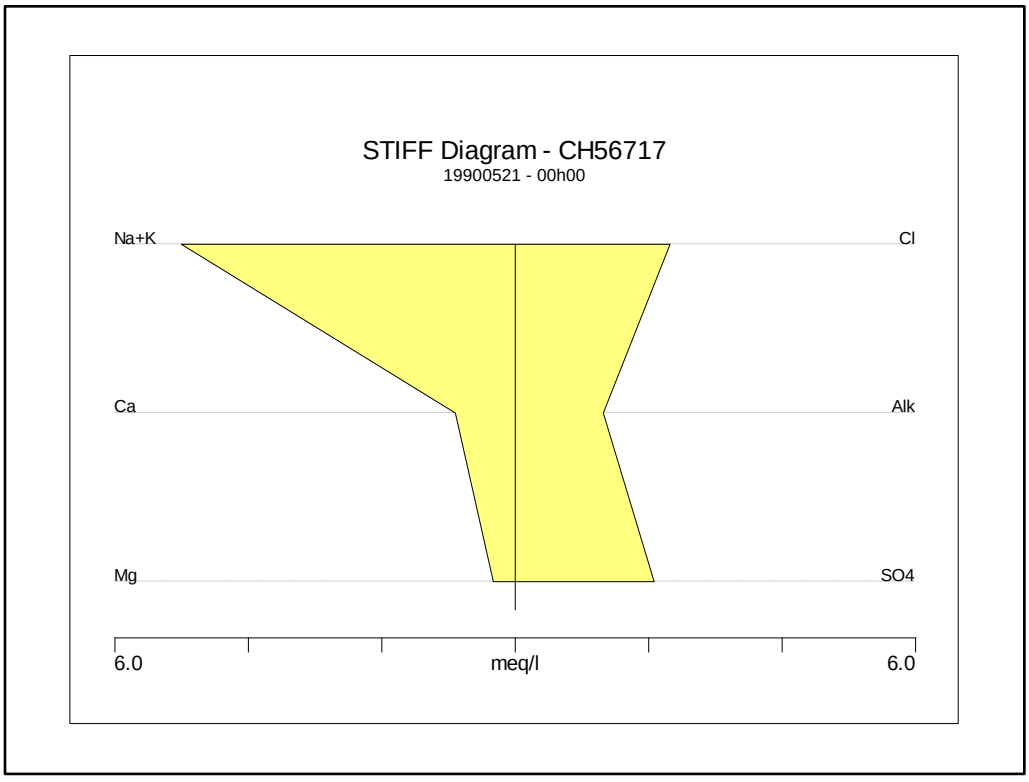

Figure 18: The Stiff Diagram for the Liselo Well

5.4.2 Groundwater Environment

Social Environment

Since there communal community within 2 Km south of the envisioned Tulela Irrigation farm depend on the shallow aquifer, contamination of this source of water has the potential of negatively affecting their sense of pride, and their association with other communities, especially the Liselo community. This can result in latent discontent and possible less open and unfriendly social associations with the project.

Cultural Environment

Although it is not clear how the local community culturally use and depend on groundwater, it is largely expected that cultural events and domestic work have some association with the availability or unavailability of water resources. Therefore, potential contamination, depletion or elevation of the groundwater table might offset or reinforce cultural events and domestic work.

Economic Environment

The livelihood of the community largely depends on stock farming and substance crop farming in which number and health of cattle is hinged on stock watering using the shallow aquifer. Therefore, probable contamination of the shallow aquifer has the potential of disrupting the community's economy and livelihood strategy.

Public Health

Health and sanitary conditions deteriorate on account of increased waste generation and infestation of harmful chemicals.

4.3 Aquifer Pollution Vulnerability (APV)

The Namibian legal framework advocates and places stewardship responsibility on all parties involved in activities which may adversely affect the environment, in this regard particular reference is made to both the water act, Act No. 12 of 1956 and the environmental act, Act No.7 of 2007 with respect to the cardinal responsibility of protecting, preserving and sustainable use water resources.

In recognition of the above referenced legal frameworks, the consultant has adopted the **A**quifer confinement **O**verburden and **D**epth to water table (AOD) index scheme to evaluate the pollution vulnerability of the Kalahari Aquifer at the proposed Tulela irrigation Maize Farm east of the town of Katima Mulilo.

Developed by Forster (1987), the AOD index scheme attempts to find the likelihood that a contaminant loaded at the ground surface will reach the water table of an aquifer given the nature of the aquifer, the nature and thickness of the aquifer's overburden.

The AOD index presented in **Table 7** is based on scales 1 to 10 of the Aquifer confinement, the Overburden strata in the unsaturated zone of above the groundwater strikes in confined aquifers, and Depth to the water table in unconfined aquifers.

Table 7: AOD index of the aquifer pollution vulnerability at the Farm and Winela east of the Tulela Irrigation Farm.

Place	Borehole	Coordinates		Confinement		Overlying Strata		Depth to Water level		AOD Index	APV
		Latt.	Long.	State	Scale (10)	Strata	Scale (10)	Depth (m)	Scale (10)		
Farm	ID39109	S17.55290	E24.20817	Unconfined	7	Porous	5	26	7	245	Moderate
Winela	ID39075	S17.50534	E24.29748	Unconfined	8	Porous	7	14	8	448	High

Allocation ratings as inferred from borehole logs are multiplied with each other to come up with AOD index. The indices reflect the following conditions:

- 0 – 150 Low APV (low)
- 151 – 300 Moderate APV (Moderate)
- 301 – 500 High APV
- >500 Extreme APV (Ext)

It should be noted that other APV schemes, like DRASTIC , could be used, but as they tend to complicate the final interpretation (Tordiffe, 2013).

Table 7 reveals that the Tulela Irrigation Maize Farm area is moderately pollution vulnerable compared to for example the Winela area which is highly vulnerable to pollution and this is mainly due to the unconfined nature of the aquifer and high direct recharge potential, the relatively deeper water table (±26 m) is a relief factor to the APV of the study area. It therefore becomes very important to take appropriate measures (*waste disposal, enhanced recharge due irrigation effluent*) as well as to closely monitor irrigation and related activities which might negatively affect the pollution vulnerability potential of the aquifer. The concern of groundwater vulnerability at the proposed Tulela Irrigation Maize Farm can be summarized as follows:

Potential cause of Impact

- (a) Solid and liquid waste disposal activities.
- (b) Use of fertilizers, pesticides and herbicides related to irrigation.

Possible Environmental Impacts

- Deterioration of the quality of groundwater

Factor for Evaluation

- extent of waste generation and disposal choices,
- (b) Locality of disposal sites,
- (c) Location of watering troughs on the farm,
- Implementation of effluent disposal permit requirements.

Measures

- Inspection by a competent authority,
- (b) Adherence to the provisions of the EMP,
- (c) Establishment of an appropriate groundwater monitoring network relating to scheduled monitoring of both water levels and groundwater quality.

Table 8: Summary screening for environmental groundwater impact

	Item	Description	Value	Comment
Social Environment	Economic Activity	Change in economic strucutre of the people in the vicinity of the farm, loss of grazing land for livestock, loss of other use values of the land as it relates to local people's livelihood strategies.	A	Measures should be put in place to avoid excessive use of groundwater that might change the local economic structure and livelihoods.
	Water Rights and Common Rights	Shouls new boreholes be developed for irrigation, their potential impact on local wells and boreholes should evaluted and monitored, particularly it relates to loweing the the local groundwater table or/and mobilizing the saline water from the underlying poor water quality.	B	Irrigation permits should be considered only where suitable soil can be utilized.
	Public Health Conditions	In the event of groundwater being polluted, the public healthy and sanitary conditions of groundwater users down stream will deteriorate on acount of increased waste generation and infestation of harmful chemicals	B	Measures should taken not pollute groundwater or/and allow waste water from oxidation or maturation ponds to infiltrated to the water table. Caution should also be exercised to avoid flies from spreading harmfull materials/waste.
	Solid Waste	Generation of construction and operational related waste.		Caution should taken not to indescriminately establish waste disposal sites on the fram.
Natural Environment	Groundwater	If boreholes will be used for water supply, the lowering of the groundwater table due over abstraction. If no groundwater is abstracted, enhanced recharge following clearing of vegetation compounded by vertical seepage from irrigation can elevate the local groundwater table, consequently making the upper freshwater aquifer very vulnerable to pollution.	A	Unconfied aquifers are vulnerable to dewatering, and groundwater abstraction activities should be restricted to at most 12 cm water table decline per month to avoid affecting sensive vegetation. With regard to enhanced recharge from irrigationa nd vegetation clearance, the associated groundwater mould should not exceed 10 cm per month.
	Fauna and Flora	Interruption of reproduction or declining of species due to change in habitat condition	B	Limited impact percieved
Pollution	Water Pollution	Pollution of groundwater by solid waste, and waste water	B	Proper location of waste site, and lining of waste disposal sites

Values: A – Serious Impact, **B** – Moderate Impact, **C** – Limited Impact, **D** – Insignificant Impact

Summary and Conclusion

- Potable ground water of the study area is associated with the upper 70 m and the lower geological layer underlain by the clay marker.

- In the Tulela Liselo Irrigation Maize farm, the groundwater piezometry of the study area is strongly controlled by the Caprivi Graben and trends in the northeast direction.

- The chemistry in the study area shows sodium chloride is the dominant hydrochemical facie.

- The AOD assessment of aquifer pollution vulnerability of the study area reveals moderate aquifer pollution vulnerability.

- Historical hydro-chemical data from the 1990 groundwater studies by DWA indicates that groundwater in the study area is largely static.

- The Irrigation Classification analysis of Tulela Liselo irrigation maize 1000 hectares of land ‘s groundwater resources falls within the C2-S2 category and has medium salinity which is suitable for plants with moderate salt tolerance provided a moderate leaching of salts from the soil occurs.

- Tulela Liselo irrigation maize 1000 hectares shows a m***edium sodium content*** that is suitable for coarse-textured or organic soil with good permeability, hazardous to fine-textured soils with high cation-exchange capability.

- In general within the Zambezi region particularly the Tulela Liselo irrigation maize 1000 hectares strongly reflect static groundwater flow regime with minor direct recharge and insignificant local under flow components. Hence, the groundwater resources in the Tulela Liselo irrigation maize 1000 hectares might not be very vulnerable to onsite pollution sources.

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Tordiffe, E. (2013). Hydrogeological deskstudy of the Kalkfeld groundwater scheme, Namibia: With special reference to environmental groundwater issues related to the proposed NamWater scheme extension that will from part of an environmental impact assessment.

6 SECTION 6: ROUTE DETERMINATION

6.0 Methodology

The water pipeline route was determined based on previous alternative route that was used by the “Katima Farm” to abstract water from the Zambezi River for irrigation in the 1990’s. In this section the same route was assessed to determine its suitability as acceptable from an environmental point of view. The technical team in-consultation with the EIA Team worked together to reach a win-win solution along this topographically challenging terrain. The general suitability of this pipeline route was unique since there was no other alternatives to be taken into consideration. The route seemed the most feasible from a technical pointof view and would be less damaging to the environment (i.e. more accessible, thus less destruction to vegetation and soil). As mentioned earlier, the proposed project will be on an area already disturbed or used for abstracting water from the Zambezi river. The proposed routes were optimized to ensure that erosion in minimized, and less damage to the B6 bitumen standard that connects to the Winela border. Also minimize the relocation of community members homesteads should be avoided during the construction and operational periods of the proposed project.

6.1 Criteria to evaluate proposed routes

Table 9 provides a list of criteria that was used for evaluating the suitability of the route alternatives from a biophysical and socio-economic point of view.

Table 9: Evaluation criteria for power and water lines routes

Aspect	Criteria	Rationale
I**nfrastructure**	Align the route alongside existing infrastructure or servitude from Zambezi river cross the B6 to the farm	Aligning the route along existing infrastructure corridors Keeping infrastructure in one corridoralso limits visual intrusion toone place.
Visual impact/tourism and recreational potential	Avoid areas used for tourism and recreation activities and potential that depend on wilderness landscapes. Keep the water pipe line at least 100m from these areas, or as far as needed to preserve important vistas if installed above ground. For this project the water pipeline will be installed below ground at depth of more than 1m.	Avoid aligning the route across or in front of areas with scenic and wilderness qualities, particularly areas visited frequently. These may presently attract tourism or do so in future and are valuable to local residents and the public.
Homesteads and farm	Avoid crossing existing homesteads, grazing areas,	Community member's assets will reduce in value or may be

Aspect	Criteria	Rationale
infrastructure	farm infrastructure and other improvements that are of socioeconomic value. Maintain a distance of 200 m from homesteads where possible	lost if the water pipeline crosses their homesteads.
Biodiversity	Avoid steep slopes, rocky ridges, hilltops and inselbergs and water courses which harbour conservation worthy plant and fauna species	To maintain the integrity of conservation worthy biota.
Topography	Avoid steep terrain, rocky outcrops, and inselbergs	These areas are difficult to access, would require roads that are prone to erosion, andwould complicate and increase construction costs.
Archaeological sites	Avoid vulnerable and important archaeological sites	Archaeological sites are important from a scientific, cultural, scientific, tourism and legal perspective, and would likely be damaged if the construction activities were to take place around them.
Construction costs	Factors affecting construction costs should be considered	Construction costs increase per every length of power line,thus the need for detours should be carefully considered.

6.2 Concluding remark on this section

In this section the route for the water pipeline was evaluated from an environmental and technical point of view. The best route using the previous Katima Farm water pipeline was selected.

7 SECTION 7: PUBLIC CONSULTATION PROCESS

7.0 PUBLIC CONSULTATION PROCESS LISELO IRRIGATION FARM

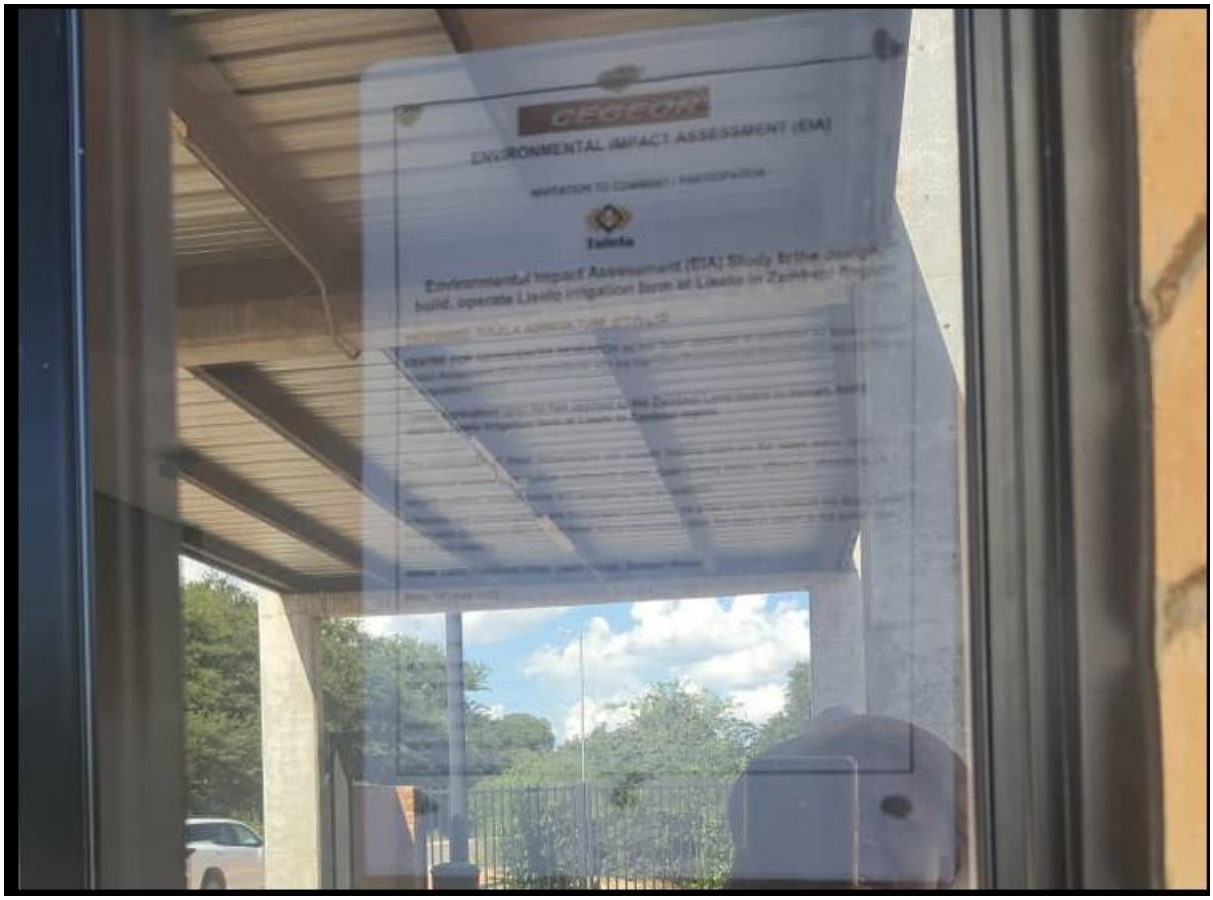
7.1 Legal and policy requirement

Environmental Management Act (2007) and its EIA regulations (2012) Public consultation is a crucial part of the EIA process. This provides an opportunity to stakeholders or interested member of the public to find out more about what is being proposed, and to raise any issues or concerns. The Environmental Management Act 2007 and its EIA regulations of 2012 are the key documents governing environmental impact assessment in Namibia. One of the key objectives of the Act is to prevent and mitigate the significant effects of activities on the environment by: “Ensuring that there are opportunities for timeous participation of interested and affected parties throughout the assessment process; and ensuring that the findings of an assessment are taken into account before any decision is made in respect of activities.” The key principle of the Environmental Management Act 2007 advocates for public participation. The principles states that “the participation of all interested and affected parties must be promoted and decisions must take into account, the interest, needs and values of interested and affected parties”. Section 21 of the EIA Regulations outlines procedure on public participation process as follows:

The person conducting a public consultation process must give notice to all potential interested and affected parties of the application which is subjected to public consultation by:

(a) Fixing a notice board at a place conspicuous to the public at the boundary or on the fence of the site where the activity to which the application relates or is to be undertaken;

Picture 1, Public consultation notification at Liselo Khuta , in Katima Rural Constituency Zambezi Region.



Picture 2, Public consultation notification at Zambezi Regional Council Ofiices, in Katima Town Zambezi Region.

(b) Giving written notice to:

i. The owners and occupiers of land adjacent to the site where the activity is or is to be undertaken or to any alternative site;

ii. The local authority council, regional council and traditional authority, as the case may be, in which the site or alternative site is situated;

iii. Any other organ of state having jurisdiction in respect of any aspect of the activity; and

Advertising the application once a week for two consecutive weeks in at least two newspapers circulated widely in Namibia.

A notice, notice board or advertisement referred to in sub regulation (2) must give details of the application which is subjected to public consultation and state:

i. That the application is to be submitted to the Environmental Commissioner in terms of these regulations;

ii. The nature and location of the activity to which the application relates;

iii. Where further information on the application or activity can he obtained:

The manner in which and the person to whom representations in respect of the application may be made.

When complying with this regulation, the person conducting the public consultation process must ensure that information containing all relevant facts in respect of the application is made available to potential interested and affected parties.

And consultation by potential interested and affected parties is facilitated in such a manner that all potential interested and affected parties are provided with a reasonable opportunity to comment on the application.

For the purpose of the Act and these regulations a notice is given to a person or a person is informed of a decision, if a document to that effect is:

(a) Delivered personally to that person;

(b) Sent by registered post to the persons last known address;

(c) Left with an adult individual apparently residing at or occupying or employed at the person's last known address; or

(d) In the case of a business-

(i) Delivered to the public officer of the business;

(ii) Left with an adult individual apparently residing at or occupying or employed at its registered address;

(iii) Sent by registered post addressed to the business or its public officer at their last known addresses; or

(iv) Transmitted by means of a facsimile transmission to the person concerned at the registered office of the business."

7.1.2 Consultation approach with Liselo Village

The following activities were undertaken to facilitate stakeholder and community participation during this EIA process:

- ♣ The I&AP list was compiled by using internet facilities. The I&AP telephone numbers were searched in the telephone directory and with the assistance of Telecom's Directory Information service.
- ♣ A Background Information Document (BID) was compiled, which was distributed via Internet and physical to the Liselo Khuta (Appendix ..1).

- ♣The BID invitation was followed up with a Stakeholder Consultation meeting .

- ♣ Advertisements to invite interested and affected parties to the public meetings were placed in the NewEra and The Republikien, The Sun, Confidente newspapers for consecutive two weeks (Appendix 2).

The public meetings for interested and affected parties were held at Liselo Traditional Khuta office at Liselo see images of the public meeting and stakeholder's engagement below.

7.1.3 The Public Meeting at Liselo Khuta

The advertisement for the public meeting was set for the 14th of April 2022, however due to unforeseen delay in flight issues, the consultant could only arrive on the 15th of April 2022. However a communication with the most affected and receiving environment and owner of the Land, Liselo community was informed of changed and rescheduled meeting date and time.

Hence on the 15th of April a briefing meeting with Ngambela Liasoni Kafunzi was briefed as the Head of the Khuta, And apologized that his subordinates had not honored for the date and time as agreed. And he 'Ngambela' requested that the meeting be held at 14:00 on Saturday 15th April at the Khuta.

Picture ..3..EAP consultant M Siyambango and Tulela coordinator Joreom Mwampole during Public Briefing at Liselo Khuta.

Picture 4.. The Liselo Executive Khuta Committee chaired by Ngambela L Kafunzi flanked by his Indunas of Liselo Khuta.

Picture ..5 Some of Liselo Community members at Liselo Khuta during onsultation addressing the issue of corner points on the map during presentation .

7.1.4 The interested and affected parties (I & AP's)

The I&APs for this project were identified using information from the existing Environmental Expert stakeholder database. Organizations were selected whom the consultant considered to be interested in or affected by this particular project. An I&APS can be defined as '(a) any person, group of persons or organization interested in or affected by an activity; and (b) any organ of state that may have jurisdiction over any aspect of the activity. Outcome of the public consultation meeting The main issue that is drawn from the public participation which took place on the 16th April Saturday, are that the public is interested in the project since it is their own interest to have such an irrigation project. Since this is a big benefit to the Liselo community The Mafwe Traditional Authority had entered into a lease hold of 5000 ha to allow irrigation of the maize with Tulela Agriculture pty Ltd.

7.1.5 Key issues identified during the public consultation process

During the public participation process the following keys issues were identified:

I. Consideration to be made for employment of general workers/labourers from the surrounding communities.
II. Can the community that was not present at the time of demarcation of the farming unit be shown the corner coordinate points? For verification.
III. How will the community members from other settlements bordering Liselo Village settlement benefits from the project?
IV. How will the employment duration be for the contract/labourers/workers and compensation rates be?
V. How will the community benefit from the excess water available for there small community gardens along side the maize irrigation farm.
VI. Will Tulela agriculture assist the Liselo community in skills farming knowledge training?
VII. How will Tulela agriculture provide for security in the area as a result of employment seekers at the irrigation farm to avoid make shift shack dwellers camping along the farm?

The identified keys issues during the public participation process above needs to be assed for potential impacts in the EIA scooping report.

The above issues of concern raised seek Tulela Agriculture (pty) Ltd and Design team for consideration.

7. 2. Concluding remark on this section

In this section, issues on public participation process such as steps or methods that were followed, process, the outcome of the public participation process, and key issues identified were presented. Tulela need to provide the EAP consultant with the conceptual design of the water abstraction servitude pipeline design from Zambezi River. Community needs a detailed comprehensive detailed business plan, as a question on the business structure was questioned. Community is also interested that in the business plan of Tulela where do they “fit” in in terms of long term lease hold as they are giving away most of their communal subsistence farming acreage. The community also requested a verification of the coordinated points on the Map reference. In summary most of the issues addressed by the Liselo public are less environmental threatening issues to the ecosystem in terms of maize farming, rather than just administrative issues. And such that during the meeting it was agreed that the Governor’s office of Zambezi Region will facilitate transport with the Line Ministry of Lands to transport the community in questions to the corner points of the allocated farming unit.

.Appendices: List of appendices

Appendix 1: Company registration of TULELA AGRICULTURE PTY LTD

Appendix 2: Allocation of Land to Tulela by Mafwe Royal Establishment

Appendix 3: Minutes of meeting Between Zambezi Land Board and Mafwe Royal Establishment

Appendix 4: Project summary Business Plan

Appendix 5: Background Information Document (BID)

Appendix 6: Newspapers adverts

Appendix 7: Attendance register and Minutes of the public consultation meetings

Appendix 8: Letter of urgent request for consideration of a ECC by Zambezi Governor

Appendix 9: CVs of consultants