Environmental Impact Assessment Report

Development of a Tilapia Aquaculture Project in Kamimbi, Siavonga District on Lake Kariba

28th June 2012
0.0 Executive Summary

0.1 Introduction

This is a Environmental Impact Statement for development of an Aquaculture Cage Culture Farm on the shore of Lake Kariba at Kamimbi Village in Siavonga District by Yalelo Ltd. The report is presented to implement the provisions of the Environmental Management Act Number 12, of 2011 read along with Statutory Instrument No. 28 of 1997: The Environmental Protection and Pollution Control (Environmental Impact Assessment) Regulations, 1997. The regulation requires that “... any plan, operation, undertaking, development, change in the use of land, or extensions and other alterations to any of the above and which cannot be implemented without an authorisation licence, permit or permission from an authorising agency or without approval from a line ministry before entry into a project implementation programme”. The Act defines an “environmental impact assessment” as a systematic examination conducted to determine whether or not a proposed project, or alteration to an existing project, or alternatives, may have significant adverse or beneficial impacts on the environment.

In line with EIA regulations, Yalelo Ltd, hereafter “the Developer” or “Yalelo”, has successfully submitted an Environmental Project Brief which describes the preliminary predictions of possible impacts of a proposed project on the environment as the first stage in the environmental impact assessment process. The EPB has since been approved by Zambia Environmental Management Agency and the Developer is authorised to produce up to a maximum of 100 tons of fish in two floating cages.

The objective of this EIA is to carry out a detailed evaluation of the environmental issues of the project in accordance with the Environmental Management Act Number 12, of 2011. The EIA has to highlight the implications of the project to the environment and also to inform the public and interested parties the project objectives, needs and constraints. This Environmental Impact Assessment also makes constructive suggestions on improving the environmental performance of the project.

The EIA study describes measures for avoiding, mitigating and managing impacts and discusses the alternatives to development. An Environmental Management Plan presented here defines the environment as “the natural and man-made physical resources; both biotic and abiotic, occurring in the lithosphere and atmosphere, water, soil, mineral and living organisms whether indigenous or exotic and the interaction between them; and the ecosystem, habitats, spatial surroundings or other constituent parts whether natural or modified or constructed by people and communities including urbanized areas, agricultural areas, rural landscapes and places of natural significant”.

The environment thus constitutes the biophysical (natural) and human (socioeconomic and political) dimension. The biophysical aspects include climate (temperature, rainfall, wind and evaporation), air topography, geology, soils, vegetation (flora) and fauna (animals) groundwater (hydrogeology), and

1 ZEMA Decision Letter ZEMA/INS/101/04/1
surface water (hydrology). The human dimension includes people, land tenure and use, archaeological, social cultural, political and economic aspects. The biophysical and human aspects are interactive.

0.2 Project Description
Yalelo Limited is an operating aquaculture company, situated in Namachembele Village, West of Kamimbi Fishing Camp in Kariba Ward of Siavonga District in Zambia. This area is 25 kilometres west of Siavonga town. Yalelo Limited’s current operations are compliant with the company’s Environmental Project Brief decision letter dated May 3rd 2012.

Yalelo plans to farm up to 7,000 tonnes of Oreochromis niloticus (commonly known as Tilapia or Bream) annually in 20 and 25 meter diameter floating cages on Lake Kariba by 2013. Yalelo’s aims to be a leading example of environmental and social best practice within the Zambian aquaculture industry and also to demonstrate the viability of large-scale sustainable fish production using Zambian resources. The project, when fully implemented will assist in offsetting the large deficit of affordable fish within Zambia and contribute significantly to the development of a rural economy of Siavonga through provision of over 260 new jobs. It is estimated that Zambia currently produces 85,000 tonnes of fish per year against an estimated demand of 145,000 tonnes. It is further estimated that approximately 6,000 tonnes of fish is currently being imported annually from China, India and Zimbabwe. The majority of imported fish is consumed in cities and townships of Lusaka and Copperbelt provinces, especially during the annual fishing ban from December to March. Yalelo’s contribution will replace current imports through locally produced fish, thus increasing national food security and achievement of the national development objective to increase production of farmed fish.

Funding of $2.3 million has been secured from an international Impact Investment fund, Liongate Venture Fund I SPC (“Liongate”). Yalelo Limited is owned 10 percent by local management and 90 percent by Liongate. The purpose of Liongate is to invest in profitable and socially beneficial projects with a highly sustainable environmental impact.

Table 1: projected Project Staffing, Production, Investment and Revenue

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<td>60</td>
<td>200</td>
<td>200</td>
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<td>Production, tonnes</td>
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<td>4,583</td>
<td>6,375</td>
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<td>Investment, US$</td>
<td>1,300,000</td>
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<tr>
<td>Revenue, US$</td>
<td>1,000,000</td>
<td>11,000,000</td>
<td>15,300,000</td>
<td>15,000,000</td>
<td>16,300,000</td>
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Source: Yalelo Business Plan (2011)

The project offers employment potential for approximately 60 rural Zambians within the first year and 200 rural Zambians in the second year of operations, growing thereafter. Women will form an important and valued part of the workforce.

The grid reference for the location of the current lake aquaculture operations is 028 39.307 East and 16 30.199 South. The depth of the Lake at the current lake aquaculture operations is 30.1 metres and average daytime water temperature in February is 29.1°Celsius.
0.3 Description of Environment
Lake Kariba lies on 480 metres above sea level and is over 280 kilometres long and up to 40 kilometres in width. It covers an area of 5,580 square kilometres and its storage capacity is 185 cubic kilometres, making it the largest man-made lake in the world. The mean depth of the lake is 29 meters; the maximum depth is 97 meters.

According to physicochemical composition of water obtained from zone 4 sites, pH at various depths is on average 7.4 which indicates that water quality is neutral. Secchi disk reading is 6, indicating that the Lake is oligotrophic i.e. it has a very low nutrient level and is an environment that offers little to sustain life. Water temperature is generally 25°C or higher. The water quality characteristics indicate that the natural conditions of the Lake are suitable for aquaculture.

0.4 Anticipated Environmental Impacts and Mitigation
The project will follow the ‘ecosystem approach’ to fisheries and aquaculture and therefore adhere to the United Nations Food and Agricultural Organisation (FAO) Code of Conduct for Responsible Fisheries and Aquaculture. The project will therefore:

1. Preserve aquatic ecosystems and protect the quantity and quality of fisheries resources, including genetic resources.
2. Avoid dumping of fish processing wastes in water bodies.
3. Avoid the depletion of other fishery stocks or wild populations.
4. Protect artisanal fisheries and commercial fishing vessels and their gears from conflict with cage culture facilities.
5. Protect small-scale farmers and local communities.

Yalelo’s activities can be divided between ‘land-based’ hatchery and processing operations and ‘lake-based’ fish growing operations. Land-based hatchery activities mainly involve ponds, a feed mill and processing plant, while off-shore activities are largely confined to ‘grow-out’ cages. The major impacts involve land use and water quality. Potential negative impacts can arise from poor farm design, construction activities, improper wastewater and effluent discharges and unqualified farm management.

The entire range of negative project impacts on land, water quality and local community can be successfully avoided. Impacts on the local community can be minimized through adherence to appropriate land use planning characterised by stakeholder consultation to identify damages that require compensation. Persons that may experience lasting and unavoidable impacts due to proposed developments can be identified through effective consultation and through discussion arrive at mutually acceptable mitigations.

Negative impacts on water quality can be avoided through investments in effluent control and treatment supplemented by good farm management practices and constant monitoring. Such management practices include a comprehensive farm design that is consistent with industry best practice such as maintenance of buffer zones, minimal site disturbance and adherence to regulatory.

guidelines on pond construction for instance. Construction of settlement basins for water intake and sedimentation pond for discharge of waste water enables control of pollution of water quality.

Similarly, careful farm design, good site selection and construction of breeding ponds can minimise habitat impacts by avoiding delicate habitats and where disturbance is inevitable retaining as much vegetation as possible and replanting where necessary. Likewise, preservation of the habitat in offshore areas where placement of cages is desired can be achieved by position cages in areas free of aquatic vegetation or where other lake users may not want to see them. Cages should be placed in areas where there is good flow of water and currents can replenish oxygen, wash away sediments so that cages are constantly replenished with water. Therefore necessary quantities of feed should be applied and these should be floating pellets that are correctly sized to the age of the fish being fed. Thus, it is possible to avoid eutrophication of lake water through correct site selection, use of high quality floating feeds and good feeding and stocking practices.

0.5 Environmental Management Plan

The aim of an Environmental Management Plan (EMP) is to avoid the possible adverse impacts of a project and to maintain the existing environmental quality. The EMP communicates all aspects of planning, construction and operation of the project, which are relevant to environment. It is essential to implement the EMP right from the planning stage and then continuing it throughout the construction and operation stage. Therefore the main objective of the EMP is to identify the project specific activities that should be considered as having significant adverse impacts, monitoring and required mitigation measures.

The main purpose of the proposed EMP is to protect the environment without which the aquaculture industry in Lake Kariba is impossible. It is therefore in the best interest of the Developer to ensure that the capacity of the ecosystem is sustained by mitigating environmental degradation that could potentially harm the enterprise.

The proposed management and mitigation measures, the environmental and social commitments that are supposed to be undertaken by the respective production managers and a framework for implementation of this management plan are for protection of the environment and sustainability of the project and the industry. These measures are consistent with the Government of the Republic of Zambia (GRZ) recommended Best Management Practice (BMP) which provides guidance for offshore cage and pond culture operations. With respect to impact on water quality, the variable units of measurements are provided, an initial value is proposed and final upper limit value also suggested.

If the source water has higher concentrations of water quality variables than allowed by the initial criteria, demonstration that the concentrations of the variables do not increase (or decrease for dissolved oxygen) by more than the final values between the source water and farm effluent is an acceptable alternative to compliance with the criteria. However, this option does not apply to pH and dissolved oxygen.

The suggested sampling procedure for cage culture shall be a minimum of three sampling stations; one in the approximate centre of the cage farm or net pen area and the other two stations least 200 m and 500 m away from the cages in the direction of the predominant wind.
For the land-based ponds, samples shall be collected near the point where effluents enter natural water bodies or exit the farm property. A water control structure at the sampling site or suitable sampling method should be used to prevent mixing of effluent and water from the receiving body. In the instance of several outfalls, they shall be sampled to prepare a composite sample for analysis. Where there are more than four outfalls, three outfalls shall be selected as sampling locations. Water shall be collected directly from the discharge stream of pipes or dipped from the surface of ditches or canals with a clean plastic bottle. The sample will be placed on ice in a closed, insulated chest to prevent exposure to light. Samples or direct measurements for temperature, dissolved oxygen and pH shall be obtained between 0500 and 0700 hours, and 1300 and 1500 hours on the same day. The average of the two measurements for each variable will be used for verification of compliance. Samples for other variables shall be collected between 0500 and 0700 hours. Source water samples shall be collected quarterly directly in front of the pump station or from the pump discharge outlet but before pumped water mixes with the supply canal. These samples enable the calculation of annual loads and establish if the limited

0.6 Conclusion

The project will sustainably improve Zambian food security; create rural employment opportunities for vulnerable groups; reduce overfishing pressure on local waterways, allowing stocks to recover; and champion Zambia in again becoming a leading regional fish producer. The project will stimulate economic development in the marginalised region of Siavonga and contribute to regional balanced development.

The project has a positive economic impact as it will make use of a previously underutilized Zambian resource in a sustainable manner for the benefit of the Zambian population. The project will assist in diversifying Zambian economic activity away from unsustainable copper mining for export. The project will also assist the national budget through the payment of corporate income tax and personal taxes by employees. The project has positive downstream impacts on suppliers of aquaculture inputs with feed and seed purchases of several million dollars per year.

The project assists and is in line with the National Aquaculture Programme. It embodies the core principles of the National Aquaculture Strategy through demonstrating the economic viability of Zambian aquaculture to other potential investors; improves access to high quality production sites such as Kamimbi on Lake Kariba; demonstrates environmental and fish health management through implementation of best cage aquaculture practices; enhances marketing of fish as a healthy food product for the population and alleviates factors responsible for slow growth of aquaculture e.g. poor access to seed, feed and markets.

The Developers believe it is evident from the foregoing that the project is environmentally sustainable and socially positive and therefore merits the support of Zambia Environmental Management Agency.
0.7 Acknowledgements

The preparation of the Yalelo Environmental Impact Statement report is a collaborative result of efforts of various stakeholders, the government and non-government institutions and individuals from Siavonga Township, Namachembele and Simaamba Villages in Siavonga District. This is not withstanding the contributions of several officials representing the Department of Fisheries, the Survey Department of the Ministry of Lands, the Zambia Environmental Management Authority (ZEMA) and Zambia Wildlife Authority (ZAWA) in Chirundu; the Ministry of Local Government and Housing, the Forestry Department and the Ministry of Health through the Siavonga District Health Management Team (DHMT).

Special thanks are extended to the Chief Simamba of the Ba-Gande Clan for his guidance and personal involvement as well on his behalf through the representatives of the Chief’s Council at all the consultative meetings held for this EIS.
0.8 Project Preparers

This EIS is a result of the combined effort of the developer and the team of consultants. The team of Consultants, Project Preparers, consist of Mr. Choolwe Mudenda, the lead author and an expert in aquaculture economics and environment. Apart from overall responsibility for the preparation of the EIS, Mr. Mudenda was also responsible for the social impact analysis component.

Mr. Hangoma G. Mudenda, a distinguished Limnologist and Fisheries Biologist in Zambia had responsibility for the biophysical environmental assessment, water quality analysis and aquatic environmental management of the project. Cartographic services were provided by GIS specialist. Ms Anastasia Banda.

The curriculum vita of the project preparers are appended to this report.

Signed:

Choolwe Mudenda, B. A. Soc. Sc. and MA (Econ)

Signed:

Hangoma Gordon Mudenda B.Sc. and MSc (fisheries biology)

Signed:

Anastasia Banda. GIS and Remote Sensing Specialist
0.9 List of Acronyms

AIDS  Acquired Immune Deficiency Syndrome
BAP  Best Aquaculture Practice
BMP  Best Management Practice
BOD  Biological Oxygen Demand
DHMT  District Health Management Team
DO  Dissolved Oxygen
DOF  Department of Fisheries
ECZ  Environmental Council of Zambia
EIA  Environmental Impact Assessment
EMP  Environmental Management Plan
EPB  Environmental Project Brief
EPPCA  Environmental Protection and Pollution Control Act No.12 of 1990
FAO  Food and Agricultural Organisation
GRZ  Government of the Republic of Zambia
Ha  Hectare
HACCP  Hazard Analysis and Critical Control Points
HDPE  High-density polyethylene
HIV  Human Immune Virus
IDP  Integrated Development Plan
ILO  International Labour Organisation
ITCZ  Inter-tropical Convergence Zone
Kg  Kilogram
MT  Methyl testosterone
NHCC  National Heritage Conservation Commission
PAP  Project Affected Persons
PVC  Polyvinyl chloride
RAP  Resettlement Action Plan
RIS  Reservoir Induced Seismicity
SME  Small Medium Enterprise
STIs  Sexually Transmitted Infections
TL  Total Length
ZAWA  Zambia Wildlife Authority
ZEMA  Zambia Environmental Management Agency
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1.0 Introduction

This is an Environmental Impact Statement for development of a Cage Culture Farm located on the shores of Lake Kariba at Kamimbi Village in Siavonga District by Yalelo Ltd. The report is presented to implement the provisions of the Environmental Management Act Number 12, of 2011 read along with Statutory Instrument No. 28 of 1997: The Environmental Protection and Pollution Control (Environmental Impact Assessment) Regulations, 1997. The regulation requires that “…any plan, operation, undertaking, development, change in the use of land, or extensions and other alterations to any of the above and which cannot be implemented without an authorisation licence, permit or permission from an authorising agency or without approval from a line ministry before entry into a project implementation programme”. The Act defines an “environmental impact assessment” as a systematic examination conducted to determine whether or not a proposed project, or alteration to an existing project, or alternatives, may have significant adverse or beneficial impacts on the environment.

In line with EIA regulations, Yalelo Ltd, hereafter “the Developer”, has successfully submitted an Environmental Project Brief which describes the preliminary predictions of possible impacts of a proposed project on the environment as the first stage in the environmental impact assessment process. The EPB has since been approved by Zambia Environmental Management Agency and the Developer is authorised to produce up to a maximum of 100 tons of fish in two floating cages.

In order for the developer to attain projected production scale of 7,000 tonnes in three years, the project must expand beyond current production levels and a full Environmental Impact Assessment is required. According to the Statutory Instrument No. 28 Of 1997 the Environmental Protection and Pollution Control (Environmental Impact Assessment) Regulations, 1997 and environmental impact statement should contain the following:

(i) A description of the project, reasonable alternatives, which may begin or increase operations to provide materials or services to the proposed project;
(ii) A description of the proposed site and reasons for rejecting alternative sites;
(iii) A brief description of the site and the surrounding environment including specifying any information necessary to identify and assess the environmental effects of the project;
(iv) A description of the raw material inputs into the project and their potential environmental effects;
(v) A description of the technology and processes that shall be used;
(vi) A description of the products and by-products of the project;
(vii) The environmental effects of the project, and reasonable alternatives, including the direct, indirect cumulative, short-term and long-term effects;
(viii) The socio-economic impacts of the project such as resettlement of the affected people.
(ix) An impact management plan containing a description of measures proposed for preventing, minimising or compensating for any adverse impact, and enhancing beneficial effects, and measures to monitor effluent streams or important environmental features which may be affected by the project; and
(x) An indication of whether the environment of any neighbouring state is likely to be affected.

Furthermore section 12 of the statutory instrument stipulates the environmental impact statement (EIS) shall contain an executive summary, stating the main findings and recommendations and shall be signed by every individual person involved in its preparation. Part VII of the statutory instrument
provides for post-assessment environmental audits. The proposed impact management plan indicated in this EIS is the basis for the monitoring framework of the cumulative project impacts.

The remainder of this report presents the Environmental Impact Assessment Report of Yalelo’s aquaculture fish cage project in Kamimbi area of Siavonga District in line with the Fisheries Act of 2011 which stipulates that an EIA or EPB is required before an aquaculture project can be given a licence. The EIA report is to enable Yalelo fish cage farm project to proceed as required by law; i.e. obtain an environmental safety clearance by evaluating the impacts of the project on: the natural environment; the natural resource base; the future management of natural resources; the man-made environment; and the health of the population.

The report is organised in sections; following this introduction is Chapter 2, description of the location of the project and particulars of the developer. Chapter 3 is a detailed description of the project, the need for the project, benefits and downstream activities and multipliers and the resources to be used.

Chapter 4 reviews the relevant legislation pertaining to various aspects of the project management. This chapter reviews all the compliance requirements of the developer throughout the project cycle and the legal framework for routine environment monitoring throughout the project life span.

Chapter 5 revisits the project activities already introduced in Chapter 3 examines the project cycle more closely from the project preparation phase through construction and the operations phase. All aspects of the project cycle components are reviewed here. Particular attention is given to the components of the operational phase to clarify the nature of the project and the probable sources of impacts on the environment.

Chapter 6 focuses on the materials and resources to be employed and how they will be produced. Chapter 7 pulls the project alternatives together, at the level of production technology; site selection and species choices. The analysis of project alternatives justifies the recommended option.

Chapter 8 presents the baseline conditions. These are considered in terms of environmental components; the socio-economic or human environment conditions; physiographic conditions which represent terrestrial and aquatic environmental resources and so on. The presentation of the baseline environmental conditions establishes the basis for discussion of project impacts in Chapter 9. The impacts are presented in similar classifications of the environment used in the preceding chapter. Chapter 9 is not simply a presentation of project impacts on the environment, but also discusses he impacts of the environment on the project. In either situation, appropriate mitigation measures are suggested.

Chapter 10 sets the environmental management plan of the project. The aim of the Environmental Management Plan (EMP) is to avoid the possible adverse impacts of a project, as well as the impacts of the environment on the project consistently for long-run maintenance of the existing environmental quality. The EMP communicates all aspects of environmental monitoring during planning, construction and operation of the project, which are relevant to environment. Therefore the main objective of the EMP is to identify the project specific activities that should be considered as having significant adverse impacts and the mitigation measures required.
2.0 Location of the Project

The Yalelo Limited Farm is located on the shore of Lake Kariba, 25 km north-west of Siavonga town. The land is 110 hectares in area. The land is in the area of Namachembele village, west of Kamimbi Fishing Camp. The land was customary agricultural reserve land, until alienation by Chief Simamba. The land is largely unoccupied, except by five fisher families and two agro-pastoralists. Most of the land alienated for the project is vacant and has been used as grazing reserve by a few fisher-pastoral families settled in the neighbourhood of the farmland.

Figure 1: Aerial Image of Yalelo Farm and Proposed Location of Fish Cage Sites

The farm has been alienated in accordance with the provisions of the Lands Act of 1995 CAP 184. Accordingly, the land has been surveyed and a survey diagram has been lodged with Siavonga District Council and is undergoing consideration for conversion from customary land tenure to

\[^{3}\text{See Appendix 1 and 2}\]
leasehold tenure and subsequently to have a formal Title of registration as required by the Laws of Zambia.

Table 2: Geographic Coordinates of Proposed Location of Cage Clusters

<table>
<thead>
<tr>
<th>SITE 1</th>
<th>SITE 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>POINT A DEPTH</td>
<td>POINT B DEPTH</td>
</tr>
<tr>
<td>E 028 39.096</td>
<td>E 028 39.143</td>
</tr>
<tr>
<td>POINT C DEPTH</td>
<td>POINT D DEPTH</td>
</tr>
<tr>
<td>E 028 39.089</td>
<td>E 028 39.101</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>SITE 3</th>
<th>SITE 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>POINT A DEPTH</td>
<td>POINT B DEPTH</td>
</tr>
<tr>
<td>S 16 30.199 30.1M</td>
<td>S 16 30.249 29.5M</td>
</tr>
<tr>
<td>E 028 39.307</td>
<td>E 028 39.008</td>
</tr>
<tr>
<td>POINT C DEPTH</td>
<td>POINT D DEPTH</td>
</tr>
<tr>
<td>S 16 30.440 33.1M</td>
<td>S 16 30.458 32.5M</td>
</tr>
<tr>
<td>E 028 39.352</td>
<td>E 028 39.113</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SITE 5</th>
<th>SITE 6</th>
</tr>
</thead>
<tbody>
<tr>
<td>POINT A DEPTH</td>
<td>POINT B DEPTH</td>
</tr>
<tr>
<td>E 028 .64.168 TEMP</td>
<td>E 028 .63.868 TEMP</td>
</tr>
<tr>
<td>POINT C DEPTH</td>
<td>POINT D DEPTH</td>
</tr>
<tr>
<td>E 028 .64.215 TEMP</td>
<td>E 028 .64.273 TEMP</td>
</tr>
</tbody>
</table>

The grid reference for the location of the current cage site, “S1” is 028 39.307 East and 16 30.199 South. The depth of the Lake at the proposed cage site is 30.1 metres and average daytime water temperature in February is 29.1°Celsius.

The sites indicated above lie over a 4 km radius in the vicinity of Kamimbi Fishing Camp. Each cage site consists of eight cages, with each cage covering an area of 314-490 m² for 20 meter and 25 meter diameter circular cages respectively. The total surface area to be covered by cages is 22,134m² upon complete expansion, which is 0.022 square kilometres. Lake Kariba has a surface area of 5400 square kilometres; therefore the proposed cages will cover less than one fifty-thousandth of the lake surface. The water depth on sites reserved for fish cages ranges from 25 to 44 metres.
2.1 Project investment

Yalelo wishes to produce *Oreochromis niloticus* (commonly known as Tilapia fish or Bream) in floating cages on the lake. The Company will be the largest professional aquaculture farm using floating cages in Zambia. Yalelo has a targeted annual fish production of 7,000 tonnes per year. Funding of $2,500,000 has been secured from an international Impact Investment fund, Liongate Venture Partners Limited.

Table 3: Projected Project Staffing, Production, Investment and Revenue

<table>
<thead>
<tr>
<th>Year</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Staff</td>
<td>60</td>
<td>200</td>
<td>200</td>
<td>250</td>
<td>260</td>
</tr>
<tr>
<td>Production, tonnes</td>
<td>417</td>
<td>4,583</td>
<td>6,375</td>
<td>6,250</td>
<td>6,792</td>
</tr>
<tr>
<td>Investment, US$</td>
<td>1,500,000</td>
<td>800,000</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Revenue, US$</td>
<td>1,000,000</td>
<td>11,000,000</td>
<td>15,300,000</td>
<td>15,000,000</td>
<td>16,300,000</td>
</tr>
</tbody>
</table>

Source: Yalelo Business Plan (2011)

This funding is expected to take Yalelo through to a sustainable positive cash-flow. The project offers employment potential for approximately 60 rural-based Zambians within the first year of operations and 200 in the second year, growing thereafter. Women form an important and valued part of the workforce. The current workforce is 50 people.

2.2 Particulars of shareholders/Directors

Yalelo is owned 10 percent by local management and 90 percent by a professional Cayman Islands based Impact Investment fund, Liongate Venture Fund I SPC (“Liongate”). The purpose of Liongate Venture Fund I SPC is to invest in profitable and socially beneficial projects with a highly sustainable environmental impact. Mr. Adam Taylor, Chief Investment Officer, is the principal representative for Liongate on the Board of Directors in Yalelo Ltd.

Table 4: Particulars of Directors

<table>
<thead>
<tr>
<th>Name of Director</th>
<th>Address of Director</th>
<th>Passport number and nationality</th>
<th>Position</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Adam Taylor</td>
<td>103 Mount Street, London, UK</td>
<td>UK, 651491829</td>
<td>Director</td>
</tr>
<tr>
<td>2. Fisho Patrick Mwale</td>
<td>Plot 197 Kasangula Road, Roma Lusaka</td>
<td>Zambian, 293171/11/1</td>
<td>Director</td>
</tr>
</tbody>
</table>

CEO: Mr. Bryan McCoy

Mr. McCoy has considerable African agribusiness and management experience. Most recently Mr. McCoy restructured and expanded Sedmane Farming, Swaziland’s leading vegetable producer and processor. Mr. McCoy has a Master’s degree in Business Administration from the Wharton University in Pennsylvania, USA. Previously Mr. McCoy has held roles as a private equity investor and business strategy consultant. Mr. McCoy’s immediate subordinates are the Chief Operating Officer, Chief Financial Officer and Head of Sales & Marketing.

Director: Mr. Fisho Mwale
Mr. Fisho Mwale, is a Director on the Board of Yalelo. Mr. Mwale has considerable management, leadership and strategic decision making skills spanning over two decades in executive roles. Mr. Mwale has been Mayor of Lusaka (2005-2009); Executive Director of Strategic Investment Portfolio (Pty), a South African investment private equity firm (2009-2011), a full time consultant with African Renaissance Institute, in addition to previous Executive positions in Zambia and abroad.

**Chief Operating Officer: Mr. Albert Nsonga**
Mr. Nsonga has a MSc. degree in aquaculture and is a PhD. candidate. Mr. Nsonga commands an in-depth technical understanding of all aspects of aquaculture production. From 2009–2011 Mr. Nsonga was a Aquaculture Technologist, UN-FAO and previously he was a consultant and freelance consultant at the African Wildlife Foundation and US Peace-Corps. His responsibility will cover all aspects of production, including the hatchery, cage culture and all aspects of operations; processing, feeding, security, engineering and fish health. He will be supported by a team consisting of the Head of Engineering, Head of Security, Factory Manager, Hatchery Manager, Production Manager and Lake Operations Manager.

**Chief Financial Officer: Ms. Cassandra Kabwe**
- Accounting Technician’s Diploma (National Institute of Public Administration-NIPA)
- Association of Certified Chartered Accountants (ACCA) – level II
- 2008-2011: Head of Finance & Administration – Self Help Africa (SHA)

**Sales and Marketing Manager: Mr. James Kaposa**
- Diploma in Business Administration, Chesford Management College
- Computer certificate, Ram House Computer College
- Diploma in Advertising and Public Relations, Cambridge Tutorial College
- Member of Zambia Public Relations Association
- 2004-2011: Country Manager, Sales & Marketing, Kariba Harvest Limited

**Hatchery Manager: Mr. Watson Pasipamire**
- BSc. Agriculture Management - Zimbabwe Open University
- Principles of Health management – Southeast Asian Fisheries Development Center, 2010
- Integrated fish farming, China, 2006
- Fish Genetics, 2003 by Kentucky State University, an online program
- Principles of Modern Management, by CPM, 2001
- Fish Farming Certificate, through Home Study College in South Africa, 1999
- 2009-2011: Assistant Production Manager, Lake Harvest (Zimbabwe)
- 2004-2009: Lake Operations Manager, Lake Harvest (Zimbabwe)

Altogether, the management team currently consists of 9 persons.

**2.3 Track record/previous experience of the enterprise**
Yalelo Ltd was incorporated in Zambia in 2011, registration certificate number 95999. The company was established to improve the availability of fish to Zambia and the region, thereby increasing per capita fish consumption, improving diets, creating rural jobs, transferring skills, improving livelihoods and lowering poverty. While Yalelo is a new company, the management team has considerable technical knowledge and practical experience in the management aquaculture production. The
concentration of staff skills and experience in cage aquaculture and marketing of fish products at Yalelo is unmatched in Zambia.

Yalelo is currently authorised to produce 100 tonnes of fish. This Environmental Impact Statement Report is required to authorize the planned steady expansion of activities.

1.5 Consultation
This report is not only a result of expert analysis, but also of public consultations with the community of Kamimbi fishing camp and the rest of the people of Namchembele Village as well as with other stakeholders representing public agencies, such as the Department of Fisheries, Zambia Environmental Management Agency (ZEMA), Siavonga District Council, Chief Simamba traditional Council and representatives of civil society and Church. The minutes of various consultative meetings held to discuss the EIA process as well as to resolve various issues arising from the EIA process are attached to this report.

A public stakeholder consultative meeting for the preparation of the Environmental Impact Assessment Report was held on January 30, 2012 in the Siavonga Lake View Lodge. This meeting was an exchange of information between the Company’s representatives; various stakeholders drawn from traditional institutions; Chief Simamba, Village heads drawn from the Traditional Council; Government and Civil Society and Kapenta industry. The meeting discussed a number of issues. The meeting was informed of the Yalelo company vision, investment programme and corporate policies. The meeting was informed that Yalelo would employ best management practices in its operations in order to avoid environmental degradation.

The EIA public consultation meeting discussed a number of items, such as the legal provisions in the Fisheries Act regarding the security of an aquaculture facility and regulations governing fishing nearby a cage culture facility. The meeting also discussed cage placements, the location of the company’s operations; company policies with regards to employment, dispute handling, sanitation, fencing and the squatters. Participants expressed satisfaction with the company’s investment projections. The meeting advised the company not to relent on consultation with community on all matters affecting them. The traditional establishment represented by the Chief in person advised the company to give preference to local persons in its employment policy, without compromising skills required so that the Company can gain local support and respect.

Following an expert scoping exercise for the EIA report, it was considered necessary to have a second community consultation meeting in Kamimbi. This meeting was held on May 12, 2012 to resolve matters relating to Lakeshore gardening activities within the 100 metre reserve land fronting Yalelo property and other issues related to anticipated increase in lakeshore traffic, health and safety and access to the reserve land by all lake users. The meeting agreed on a number of issues as given in the minutes of the meeting appended to this report.

3.0 Description of project
The project involves development of a fully integrated cage culture fish farm and fish processing operation. A phased approach will be taken to ensure all activities are implemented reliably and in accordance with best practice. Core ‘grow-out’ activities will begin with without a hatchery, feed mill or processing plant. Within 24 months each of these facilities will be developed.
At full scale, the project will consist of:

- 48 floating ‘grow-out’ cages, capable of producing 7,000 tonnes per year
- A 50 pond hatchery, capable of producing 27.5 million fingerlings per year
- A feed mill capable of producing 15,000 tonnes of aquafeed per year
- A processing plant, capable of processing 7,000 tonnes of fish per year

Each of these components is described in further detail below.

The size of the proposed circular grow-out cages are 20 meter circumference with 9 meters depth, giving a volume of 2,826m$^3$ and 25 meters diameter with 6 meters depth, giving a volume of 2,943m$^3$. The cage material is high-density polyethylene (“HDPE”) piping and brackets. Two nets will be used for fish containment below water with one ‘bird net’ above water. Nets will be made of HDPE and Nylon. In line with Fisheries Department recommendation, it is proposed to mark 100 meters of cage perimeter with buoys. Each cage site consists of eight cages, with each cage covering an area of 314 and 490 m$^2$ for 20 meter and 25 meter diameter circular cages respectively. The total surface area to be covered by cages is 22,134m$^2$ upon complete expansion, which is 0.022 square kilometres. Lake Kariba has a surface area of 5400 square kilometres; therefore the proposed cages will cover less than one fifty-thousandth of the lake surface.

The initial focus of the company was on the core task of successfully growing out fish in off-shore cages, which has been recently accomplished under the approval of the Yalelo EPB. A hatchery and feed mill will now be developed to ensure supply-chain stability. In year three, a processing factory will be constructed to enable exports of process fish to surrounding countries. Yalelo expects to develop operations according to the following schedule:

**Phase One (Immediately following EIA approval):**

- Approval of Environmental Impact statement and aquaculture license. Offshore cage production of up to 7000 tonnes of tilapia per year.
- Establishment of onshore hatchery production of up to 30 million fry and fingerlings per year for stocking the offshore cages.
- Commencement of fish sales in Zambia.
- Limited processing to include freezing and gutting of up to 3,500 tonnes of fish per year.

**Phase Two (2013, following Phase 1):**

- Establishment of a 15,000 tonnes per annum extruded floating pellet feed manufacturing plant on site.
- Full processing (filleting, canning, flavouring etc.) of fresh and frozen fish.
- Export to neighbouring countries

Normalized operations upon full completion of Phase 1 and Phase 2 will consist of:

- Fingerling production of 27.5 million fingerlings per year (2.3 million per month) stocked in 8 x 2,827 m$^3$ and 40x 2,943m$^3$ floating cages. The hatchery, on-shore, will consist of 50 ponds.
• Production of between 6,960 and 7,200 tonnes of fish per annum from two crop cycles of 3,480 and 3,510 tonnes each.

• Expected yield is from 30 to 35 kg of fish per cubic metre from 11.6 ha of water surface area representing output of 3,480 and 3,510 tonnes of fish per crop depending on initial stocking sizes and survival rates.

• Approximately 4,000 tonnes will be frozen and gutted and 3,000 tonnes filleted.
4.0 Review of Relevant Legislation

Aquaculture has several legal and environmental implications. It is mediated by geographic and social factors and technical (biological) norms. In general, it is useful to think of aquaculture as any other natural resources based activity akin to poultry, whose intensification is inevitable when market conditions permit.

Environmental concerns are minimal at low/small scale and operations. Intensification of natural resources use is associated with public welfare risks since such activities depend on publicly regulated resources. This is true of aquaculture. Aquaculture requires ample water supply and suitable land. For aquaculture to become successful, it needs a balance between land and water uses and conservation needs. As a result, it benefits from water, fish and land use regulatory systems. It requires legal and institutional measures to secure the rights of operators to access land and water resources in line with public land use objectives and equitable water right allocations. Van Houtte (2003) Fundamental Techniques of Environmental Law and Aquaculture Law\textsuperscript{5} sums it up that aquaculture development is intrinsically dependent on water quality and quantity changes caused by surrounding users (aquaculture, domestic industrial) of the same aquatic resources (surface water; river; reservoirs; lake; ponds, ground water etc.) and by natural events like storms and floods. Beyond received pollution, aquaculture may also cause pollution and harm to the surrounding environment. The legal issues and facts may be summed up as follows:-

4.1 The Fisheries Act No. 22 of 2011

The Fisheries Act No. 22 of 2011 provides for regulation of aquaculture development planning and aquaculture licensing, control of fish movements and introductions. The introduction of any species of fish or the importation of any live fish without the written permission of the Director of Fisheries is prohibited., there is no provision for traceability of authorised introductions such as control of subsequent translocations within the country because the ‘certificate of origin’ is only used for dead fish and not for control of live fish movements across district boundaries. Equally absent are sanitary guidelines on importation of live fish specimens. Similarly, there is no control for the species of aquatic life that may be introduced into any aquaculture facility or provisions for regulating location, design and materials used in the construction of the aquaculture facility and to the equipment that used therein.

The Fisheries Act No. 22 of 2011 is silent on control and monitoring of water quality for aquaculture purposes. However, it is very clear on measures to safeguard the property rights in aquaculture by restricting unauthorised interferences and obstructions to an aquaculture facility. It also prohibits the use of fish growth enhancing hormones.

4.1.1 Best Aquaculture Management Practices

Best Aquaculture Management Practices, as published by the UN FAO, will serve as the managing principal for Yalelo’s operations in instances where regulation is not outlined in Zambian regulation. In instances where applicable Zambian regulation exists, the Zambian regulation will take priority.

The Best Management Practice Guidelines which stipulate measures for proper sanitary conditions of fish and fish products and prevention of the escape of fish from the aquaculture facility in addition to preventing and controlling the spread of diseases of fish are still in draft and are at best still voluntary as they are yet to be legislated. Yalelo will adopt the Best Aquaculture Management Guidelines and participate in initiatives leading to legislation of the Guide. Other relevant guidance for best cage culture management are contained in the International Standards for Responsible Tilapia Aquaculture 009 World Wildlife Fund, (WWF) 2009 and the FAO Guidelines for Responsible Aquaculture.

4.2 Food and Drug Act (CAP 303).
Provisions for marketing of fish intended for human consumption are contained in the Food and Drug Act (CAP 303). However, there is no mention of fish products of aquaculture origin. The law appears to consider fish in general without distinguishing their origin. Similarly, measures for disposal of dead fish material or waste from any aquaculture facility operated by the licensee including consents and notifications required in respect thereof are needed. Yalelo Ltd will be guided by this Act in as far as handling of food is concerned. HACCP will be employed to ensure high quality standards are maintained.

4.3 Town and Country Planning Act CAP 283
In so far as zoning for aquaculture sites, the Town and Country Planning Act Cap 283 of the Laws of Zambia is limited because planning permission is only required for the development or subdivision of land in areas for which a development plan exists or in other areas specified by the Minister. The second Schedule to the Act sets out the matters for which provision can be made in a development plan, including the reservation of areas for agriculture, horticulture and forestry. The Act does not refer to the use of land specifically for aquaculture purposes, unless the definition of agriculture in law is used to apply to aquaculture. Furthermore, the Act does not apply to land falling under customary tenure. The law will be upheld and will ensure that all buildings erected for Yalelo operations are on approved plans.

4.4 The Lands Act of 1995 CAP184
The development of customary land is provided by the Lands Act of 1995 as amended in 1996 which defines land alienation procedures and requirement for conversion of tenure from customary to statutory regulation for development purposes. Accordingly, it is implied by both the Town and Country Planning Act (1961) and the Lands Act of 1995 that no development can take place in customary land unless the land is converted to statutory tenure. This is a legal obstacle to development of aquaculture and application of statutory planning regulations on customary tenure. Yalelo will be guided by this law in all its operations regarding land.

4.5 Water Act (1949)
The Water Act (1949) classifies different water uses as primary, secondary or tertiary, with water for irrigation and for “pisciculture” (fish breeding) being classified as a secondary use. The use, diversion and apportionment of all water should be in accordance with the terms and conditions of the Act; provided that a landowner has the right to take free of charge such private water occurring on his land as he/she may need for his own primary, secondary or tertiary use. Any person who wishes to impound and store or divert water from a public stream for primary, secondary or tertiary use must apply for permission to the Water Board. Any land owner who demonstrates a need for water for a
secondary use may claim another’s surplus upon eventual payment of a reasonable compensation for any capital expense incurred or work performed by the deprived party in making the claimed water available.

This Act excludes all shared water bodies including Lake Kariba and the Eastern Province. For Lake Kariba, regulation is with the Zambezi River Authority.

4.6 The Environmental Management Act Number 12 of 2011

The Environmental management Act No. 12 of 2011 renames the Environmental Council as the Zambia Environmental Management Agency and provides for integrated environmental management; the protection and conservation of the environment and the sustainable management of natural resources. The Act, inter alia, provides for the conduct of strategic environmental assessment of policies, plans and programmes likely to have an impact on environmental management; provides for prevention and control of pollution and environmental degradation; for public participation in environmental decision making and access to environmental information. The Environmental and Management Act No. 12 of 2011 (EMA) through which the environmental Impact Policy is administered has several mandates for projects. The Act requires that for project development the planning, implementation and development of options are environmentally sound and sustainable. It also makes it mandatory that any environmental consequences are adequately addressed and mitigated in the project design. EMA provides for the sustainable management of natural resources, protection of the environment and prevention of pollution and environmental degradation. The Act deals with the protection of the environment and compels project developers to show that there are adequate mechanisms to guarantee protection of the environment. This environmental impact study is thus in compliance with this statutory requirement.

The first schedule of the Act provides categories of projects that require EIA’s before implementation, and the proposed project is one such activity. The Act and its associated statutory instruments provides for the issues relating to effluent management, solid waste management, air pollution and water pollution. All these are critical issues that relate to this proposed development.

4.6.1 Environmental Protection and Pollution Control (Environmental Impact Assessment) Regulations, 1997

The Statutory Instrument No. 28 of 1997 provides for the protection of the environment and the control of pollution; regulates the requirements for compulsory project briefs and Environmental Impact assessments (EIAs).

According to the EIA regulations, an Impact Statement is required for all projects listed in the First Schedule to the Regulations, including fish farms with a production of 100 tonnes or more per year. An Impact Statement is also required for the introduction of alien species of flora and fauna into the local ecosystem.

In addition, EIAs are obligatory for all projects specified in the Second Schedule, including all projects located in or near environmental sensitive areas such as areas supporting populations of rare and endangered species or major water catchment areas.
4.6.2 Water Pollution Control (Effluent and Waste Water) Regulations (1993),
In accordance with the Water Act (1949), which generally prohibits the pollution of any public water in order to protect human, animal and plant health, the Environmental Protection and Pollution Control Act, replaced by the Zambia Environmental Management Act, establishes - inter alia - water quality and pollution control standards and determines the conditions for the discharge of effluents into the aquatic environment.

The Water Pollution Control (Effluent and Waste Water) Regulations (1993), established under this Act, state that any owner or operator of any industry or trade discharging effluent into the aquatic environment should apply for a licence to the Environmental Inspectorate, established under the Act. The application should contain information relating to the quality and quantity of effluent and its treatment. The licence to be issued should conform to the conditions and standards for chemical and physical parameters contained in the table of standards for effluent and waste water in the Third Schedule to the Regulations. The licence is valid for 36 months and may be renewed for a similar period. The Inspectorate also deals with the application and issuance of licences to withdraw water from a water course or other source for the treatment of effluent.

4.7 Stock Diseases Act CAP 252 [27th December, 1963]
The Draft Best Aquaculture Practice Guide states that ‘Banned antibiotics, drugs and other chemical compounds shall not be used. Other therapeutic agents shall be used as directed on product labels for control of diagnosed diseases or required pond (read fish cage) management, not (for) prophylactic purposes. The guide prohibits the use of banned drugs, hormones and use of antibiotics as authorised and conducted by a veterinarian or fish health specialist.

The BMP guide recommends focus on the prevention of disease rather than disease treatment with chemical compounds. The best ways of controlling disease are to avoid stocking diseased Tilapia, adopt fallowing and “all in, all out” stocking procedures at cage and net pen sites, and avoiding stress by minimising handling and maintaining good water quality. It suggests that farms should develop health management plans that indicate procedures to avoid the introduction of disease, protocols to maintain water and soil quality and fish health-monitoring and disease diagnosis techniques. It further suggests the steps to be taken when a diagnosed disease will be treated with approved chemicals and lists approved chemicals.

4.8 Agriculture (Fertilisers and Feed) Act (CAP 226)
The Agriculture (Fertilisers and Feed) Act regulates manufacturing of feeds and this applies for aquaculture feed making plants. Yalelo will ensure that all its operations are guided and falls within its jurisdiction.

4.9 Factories Act CAP 441
The Factories Act regulates conditions of employment where machinery is employed and sets the safety, health and welfare of persons employed and provides for the safety, examination and inspection of certain plant and machinery.
4.10 Inland Waters Shipping Act CAP 466
The Inland Waters Shipping Act provides for registration and safety of vessels used on inland waters of Zambia, for the safety of passengers and cargo, for the competency of masters and crews, Life-saving appliances to be carried. The Act is enforced by Zambia Police Service and the Local Government Administrator. Yalelo will ensure that boats are registered, are in a sound condition, all floating devices, fire extinguishing equipment, lights are in place to meet this Act.

The Act repeals and replaces the Natural and Historical Monuments and Relics Act and to provides for conservation of ancient, cultural and natural heritage, relics and other objects of aesthetic, historical, pre-historical, archaeological or scientific interest. It regulates the archaeological excavations and export of relics and is administered by the Director, Conservation Commission of Zambia. The Act regulates protected sites and any change of an environment will need authorisation from this authority e.g. felling of trees on any protected area/s.

4.12 Investment Act CAP 385
The Zambia Investment Centre administers the Investment Law (1993, as amended) and provides a one-stop support facility to investors. The Act is also meant to assist in securing from any Ministry, government department, local authority or other relevant body any permission, exemption, authorisation, licence, bonded status, land and any other thing required for the purpose of establishing or operating a business enterprise. Accordingly, the Act provides that any person investing in a business should apply for an Investment Certificate. The Procedures and Guidelines for Issue of an Investment Certificate specify the requirements to be met, and include submission of a Impact Statement or an EIA. However, there is no specific reference to investment in the aquaculture sector even though aquaculture is included in the definition of “investment” under the Act as any ‘contribution of capital, in cash or in kind, by an investor, to a new business enterprise, to the expansion or rehabilitation of an existing business enterprise or to the purchase of an existing business enterprise from the State’.

4.13 Local Government Act CAP 281
The Local Government Act CAP 281 provides for the establishment of Councils in districts and sets out the functions and administrative structure of local natural resources including responsibility for conserving natural resources, preventing soil erosion, controlling weeds, controlling local forest, operating sanitation services for refuse and effluent and establishing and maintaining drains and sewerage systems. Any sugar estate or out grower scheme will operate within the jurisdiction of the respective District Council.

Council By-Laws: The District Councils are mandated under the Local Government Act to enact by-laws for the efficient administration of local authorities. This includes by-laws on levies which have a direct bearing on farmer activities. New sugar estates and/or out grower schemes may be affected by such levies.

Yalelo Ltd will maintain all the documents proving compliance with local and national authorities on land and water use (e.g., permits evidence of lease, concessions and rights to land and/or water use). This includes documents proving compliance with all tax laws and labour laws and regulations.
In addition, the company will also comply with regulations or permits concerning water quality impacts. This will be in line with the routine Environmental Management and Impact Monitoring System proposed herein this document.

### Table 5: Legal Compliance Framework for Yalelo Limited

<table>
<thead>
<tr>
<th>Legal Instrument</th>
<th>Environmental Issues</th>
<th>Compliance</th>
</tr>
</thead>
</table>
| The Environmental Management Act (EMA) and associated Statutory Instrument | Prevention of pollution and environmental degradation of Lake Kariba, monitoring and managing the EIA  
- Pre-treatment of factory and pond effluent  
- Transportation of solid waste from the factory only under licence  
- Prohibition of pollution of Kariba water from the cages and from effluent from the fish farm  
- Prohibition of atmospheric pollution (fugitive dust) from the feed mill. Minimize air pollution through dust emission from feed mill | Through-out the operation phase of the project Yalelo Limited will ensure that its effluent and solid waste meet the stipulated requirements. Pre-treatment facilities should be installed prior to expansion. Licences should be obtained prior to commencement. Dust extractors should be installed on hammer mills in the feed mill before operation and changed as need arises |
<p>| Water Act        | Prohibition of pollution, avoid excessive pollution by meeting the stipulated standards for effluent discharge.                                                                                                     | Compliance should be maintained through-out the operation phase                                |</p>
<table>
<thead>
<tr>
<th>Legal Instrument</th>
<th>Environmental Issues</th>
<th>Compliance</th>
</tr>
</thead>
<tbody>
<tr>
<td>The Urban Councils Act</td>
<td>Factory effluent should meet the stipulated quality standards, solid waste should be properly disposed off</td>
<td>Compliance should be maintained through-out the operation phase</td>
</tr>
<tr>
<td></td>
<td>Acceptable effluent discharged in municipal sewers, pre-treatment of factory effluent</td>
<td></td>
</tr>
<tr>
<td>Inland Waters Shipping Act</td>
<td>Satisfy navigation requirements at the cage site and in lake operations</td>
<td>Compliance should be maintained through-out the operation phase</td>
</tr>
<tr>
<td>Factories and Works Act of 1995</td>
<td>Maintenance of workers safety in the factory</td>
<td>Compliance should be maintained through-out the operation phase</td>
</tr>
<tr>
<td>The Zambezi River Authority Act</td>
<td>Maintenance of Sanyati basin water quality in an acceptable state (no pollution), acquisition of water abstraction rights for the water plant</td>
<td>Compliance should be maintained through-out the operation phase</td>
</tr>
<tr>
<td>Siavonga Lakeshore Combination Master Plan</td>
<td>Employment benefit to locals, accrual of revenue to Siavonga district, contribution to local infrastructure provision</td>
<td>Compliance should be maintained through-out the operation phase</td>
</tr>
<tr>
<td>Laws/Protocols/Policies) for Gender</td>
<td>No gender discrimination, equal employment opportunities</td>
<td>Compliance should be maintained through-out the operation phase</td>
</tr>
</tbody>
</table>
5.0  Project Description and Activities

The project involves development of an intensive fish cage farm in Kamimbi area in the district of Siavonga on Lake Kariba. The project has two sets of activity; preparation, followed by construction and operations. Each of phases is described below.

5.1  Preparation

The preparation phase was completed in May 2011. During the preparatory phase, all activities were performed in accordance with the Yalelo Environmental Project Brief to minimise environmental impact. The purpose of the preparation phase was to determine the economic and technical viability of the production operations. Commercial trials included full environmental abatement measures.

The following activities were undertaken during preparatory phase.

i. Clearance of scrub bush from a one hectare area (the “Research Area”) without felling of tree stands;
ii. Securing of the cleared operational base with fencing.
iii. Clearing of an access road to the Research Area.
iv. Place refurbished shipping containers to provide temporary office and storage facilities for the Research Area.
v. Construction of a deep access ramp for boats to enter the lake.
vi. Design and testing of floating cages. Material sourcing and supplier relationships established.
vii. Research of materials, designs, suppliers and market considerations.
viii. Stocking of two floating fish cages with locally produced Oreochromis \textit{Niloticus} (Nile Tilapia) fingerlings to test growth performance.
ix. Initiate local stakeholder dialogue to accommodate all interests of Lake Users.
x. Preparation of Environmental Impact Statement

5.2  Construction

Construction and operations activities take place simultaneously. Construction is ongoing as production activities expand and require additional facilities. Construction involves establishment of water and land based facilities to facilitate operations. The commencement of the construction is depended on approval of the EIA. The Local Authority and Department of Water Transport will be involved in authorisation of buildings and deployment of water vessels. The scope of construction works is as follows:

i. Clearance of vegetation from up to four hectares of land for the placement of administrative facilities e.g. offices and stores;
ii. Security fencing of administrative area;
iii. Clearance for an earthen access road from the administrative area to the main Munyama Siavonga road;
iv. Construction of up to fifteen permanent brick buildings for use as store rooms, canteens, workshops, toilets, processing plant, feed mill and offices;
v. Set up of utilities, including electricity, water and septic system;
vi. Mooring facilities for six fish cage sites (48 individual cages)
vii. Fish hatchery facilities consisting of up to five hectares of land-based ponds for fish breeding and fingerling growth (53 ponds)

At all times Occupational Health and Safety Policy and Community Health and Safety Policy will be strictly enforced. These policies are attached as appendices.

The construction phase is expected to begin immediately upon approval of the Yalelo Environmental Impact Assessment and will last approximately one year. Upon completion, physical facilities will include:

- **Production:**
  - 48 floating cages on the lake divided between 6 sites

- **Hatchery:**
  - 25x Breeding ponds
  - 12x Nursery ponds
  - 16x Holding ponds
  - 2x settling ponds
  - Feed storage
  - Hatchery building

- **Processing**
  - Processing and packaging factory
  - Loading & logistics area
  - Ice production plant

- **Feed Mill**
  - Mill building
  - Ingredients store room
  - Finished feed store room

- **Employee Welfare**
  - Staff accommodation
  - Canteen
  - First aid clinic

- **Shared Resources**
  - Management offices
  - Engineering workshop
  - Store rooms
  - Pump plant
  - Associated auxiliary service facilities within the site area, feeding from main grid e.g. electricity and service roads and drinking water supply.
5.3 Operations

Operations will make use of the infrastructure developed during the construction. The nature of operations will involve all aspects of production, stocking, and feeding, harvesting and post-harvest operations as follows:

5.3.1 Off-shore cage farming activities

Offshore floating cage activities will involve:
- Feeding of fish in each cage up to 5 times daily
- Daily harvesting of fish from select cages
- Diving to check cage netting for holes
- Sampling of water and local environment to ensure environmental impact management
- Security patrols to avoid theft of fish

The operations will take place across all six cage sites, consisting of 48 cages in total, using powered boats and stationary floating pontoons.
5.3.2 On-shore hatchery operations

Onshore pond activities for fish breeding will involve breeding and nursery operations. These activities require a number of facilities; a broodstock holding facility, fish quarantine facility and effluent treatment ponds.

**Breeding Ponds:** It is proposed to construct 25 breeding ponds of 200 square metres each to create a total breeding area of 5000 m$^2$. Each pond will be lined with bricks walled and aerated with blowers. Each pond will produce at least 100,000 fry per month for nine months of the year.

**Holding Ponds:** In addition to breeding ponds, the farm will have 12 brood stock holding ponds of 900 square metres each. The total extent of holding ponds to be constructed is 10,800 m$^2$. These ponds will be lined with bricks to hold four sets of parent stock for breeding. The brood stock will be segregated to maintain genetic purity and for resting or conditioning purposes. The holding ponds will be aerated with 15 paddle wheel aerators of 2HP each to maintain sufficient supply of oxygen to brooders.

**Primary Nursery Ponds:** A total of 15 earthen fishponds each measuring 750 square meters will be needed for androgenisation and primary nursery of fry to 3 gram size. In addition blowers will be used to aerate this facility as well. Androgenisation will be in hapas, about 16 per fishpond. Effluent from androgenised facility will be retained for over 76 hours in a biological treatment pond before discharge via a constructed wet land.
**Pump station:** The breeding facility will be supplied with water through a floating pump station with three centrifugal 30HP and 3 phase pumps off-shore. At least two of the three installed pumps will be running at any time. Water will be delivered to all parts of the farm as and when required through a system of PVC pipes.

**Nursery feed storage:** For bio security reasons, nursery feeds will be kept separate from grower feeds in a nursery feed warehouse.

**Effluent Treatment Ponds:** Sometimes referred to as waste stabilisation ponds are shallow rectangular aerobic ponds with a depth of 0.7m used for safe treatment of waste water from the fishponds. Two ponds will be used of 80m x 70m x 0.7m, giving an individual surface area of 4800 meters square and a combined area of 9600 meters squared. The volume of each pond is 3360 meters cubed and the total volume is 6720 meters cubed. Vegetation such as reeds, duckweed, etc. is planted in these ponds and as a result Biological Oxygen Demand is reduced; removal of nutrients and filtration is achieved. The discharge from these ponds will flow slowly over the ground surface to the lake. A major portion of the effluent will seep into the ground prior to reaching the lake.

**5.3.3 Fish processing**
Initially the majority of harvest fish will be sold fresh, ungutted and packed in ice, with up to only 1500 tonnes frozen and gutted. After year one, up to 4000 tonnes will be frozen and 3000 tonnes further processed. Further processing will include gutting, filleting, skinning, canning and flavouring.
Processing activities will employ up to 100 individuals, especially women, and will take place inside a clean processing factory which meets all regulatory requirements.

5.3.4 Feed Mill
Yalelo intends to construct an aquaculture feed manufacturing plant within 36 months of starting operations. This plant will have an annual production volume of 14,000 tonnes per year. In animal feed manufacturing scale, this is a medium sized plant.

Aqua-Feed Production Flow Chart:

The production process will entail the following steps:

1. Ribbon blender: blends ingredients e.g. soybeans, maize, wheat
2. Bucket Elevator: raises blended feed up to storage hopper
3. Storage hopper: stores blended feed
4. Conditioner: applies correct moisture and humidity settings
5. Twin-screw extruder: high pressure combines ingredients, removes moisture and forms pellets
6. Air conveyor: transports pellets to oven by blowing
7. Oven: cooks pellets
8. Air conveyor: transports pellets to roller by blowing
9. Roller: rolls pellets to ensure correct size
10. Cooling conveyor: places pellets in normal air temperature to cool
11. Air conveyor: transports pellets to sifter by blowing
12. Sifter: sieves pellets to ensure none are above 3mm
The design and location of a feed mill will be with regard to soil conditions and whether or not an area is prone to flooding. It is important that the mill be located so that any impacts from wet conditions are minimized and the area kept free of heavy undergrowth and bushes. It is equally important that areas prone to flooding, inundation and fire should be avoided if at all possible. Therefore the mill will be located in a way that permits cost effective expansion of mill facilities in future and easy change of equipment as new techniques in milling evolve and/or the culture species change. Flexibility in the mill design is vital to remain competitive. Safety and hygiene factors should be built into the plant design such that buildings should be designed to prevent the entrance and harboring of vermin and birds.

Selection and purchasing of raw ingredients, including ingredient quality control

Quality feed begins with quality ingredients and Yalelo’s will make sure that the ingredients used for making the fish feed are wholesome and safe. Ingredients will meet animal feed ingredient grade. Variation in quality of inputs will be closely monitored through periodic sampling to verify that the ingredient specifications are being met.

All incoming ingredients will be inspected and tags/labels will be read for trace minerals and other additives. Mouldy, treated/dyed or otherwise discoloured grain or other ingredients will not be used for any feed or food. The Yalelo aquaculture feed milling and all its facilities will be in compliance with all government regulations and good aqua feed manufacturing practices. Each batch will be subjected to a strict system of traceability and quality assurance.

Yalelo feeds will be of high quality and consistent with nutritional requirements of species and age of fish being fed. This process will include a comprehensive system of record keeping for appropriate standards, grade and formulation. This documentation is vital for product traceability.

Receiving of ingredients

All incoming ingredients will be verified for correct labelling of product, product specification, cargo destination, lot numbers/date, and regulatory compliance.

Before acceptance and unloading procedures begin, the following factors will be considered: colour of the product, odour of the product, presence of any foreign material, presence of any insect infestation, granulation (texture), density of the product, moisture, weight, and other appropriate factors (including temperature).

Documentation allowing a “paper trail” or chain of custody will be maintained which will include: type of ingredient received, date received, shipper, supplier, unloading assignment, number of bags, bag size, lot number, quality comments, and receiver’s signature.

Both bulk and bagged ingredients will be used in a manner such that first-in, first-out rotational procedures occur.

Storage and handling of ingredients and finished goods

Feed ingredients which are dry before processing will be kept dry and cool and used on a first-in, first-out basis. As a general rule the moisture percentage will be less than 13%.
The bins in which these ingredients are commonly stored will be cleaned monthly, or as indicated by experience, to prevent the build-up of dust and fragments of feedstuffs. The elevator legs, other conveying equipment and spouting will also be routinely inspected and cleaned out for the same reasons.

Depending upon the source and nature of bulk feedstuffs, ingredient cleaning may be necessary. Grain cleaning systems, designed to remove broken seed, tramp metal, and other foreign materials will be used. Bins, silos, warehouses, and ingredient handling systems will be designed and set in such a way that moisture, rodents, birds and other pests are denied access. Regular cleaning of storage facilities will assist in assuring a high quality finished product.

In the unlikely event that a batch is misformulated, contaminated or returned, it will be stored such that it does not contaminate other feeds or feed ingredients. If such feed cannot be reprocessed, it will be destroyed in a sanitary manner. A paper trail will be maintained for quality of feeds produced and feeding performance.

**Feed ingredient processing**

“Processing” refers to the individual or collective mechanical treatments applied to single or multiple feed components during the manufacture of compound aquatic feeds. These processes are carried out to modify the physical and nutritional properties of the ingredients and of the finished feed to ensure a consistent quality product. Key processes may include: batching, mixing, particle size reduction, conditioning, post pellet conditioning, fat coating, drying/cooling, crumbling and bagging. Magnets will be located above all processing equipment and be checked and cleaned as required by the production superintendent.

All equipment operators will be familiar with basic equipment operation, such as that contained in the particle size reduction operator’s manual, pellet mill operator’s manual and extrusion operator’s manual or other mill equipment manuals.

Before starting the equipment, the operator will check the flow of the product to its destination to prevent cross-contamination. Particle size reducing machinery (roller mill) will be routinely checked for correct particle size. When pelleting, the product will be checked for pellet durability and pellet water stability. The products will also be checked for shape, bulk density, floating, slow sinking, or sinking, and also routinely checked for correct particle size. Turn heads, distributors, diverter valves and spouting will be routinely checked for operability, leaks and accuracy.

**Feed formulation and manufacturing**

Feeds will be manufactured according to a formula recommended by a competent nutritionist and will be specific for tilapia fish being fed and intended farm production system.

The feed plant will use locally available and least-cost formulation of ingredients. The coarse grains and possibly other ingredients will be ground in a hammer mill, roller mill or otherwise prepared by appropriate means to allow uniform mixing of the ingredients to formula specifications and further processing by pellet mill or extrusion to the cooled and finished product. The feed, properly cooled and dried after processing, will be ready for sacking or bulk delivery to the farm.
An important factor is the conditioning and cooking process of the mash. The starch will gelatinize so that the feed is digestible and maintains its integrity in water. This will assure that the feed nutrients are consumed by the animal and do not end up as fertilizer or potential pollutant within the intended farm production system. Formulations will be determined by the Yalelo’s resident nutritionist, based upon the known dietary nutrient requirements of the tilapia fish and farming system for which the feed is being formulated, prior practice, and research findings.

The mill will use reasonable and accurate nutrient specifications for each ingredient. The feed miller/nutritionist will stay abreast of current research knowledge and findings.

The production manager will be responsible for the plant having a complete set of current formulas for the tilapia fish to be fed.

All formulas will indicate: the formula identification (number), feed name (type and species), effective date, weight/percent each ingredient, and drug/medication (if used). Obsolete formulas will be filed at the feed mill for at least one year after last use.

Packaging and labelling
The function of packaging is to protect the finished feed from light and moisture and other environmental contaminants. Together with labelling, it will tell the Yalelo feeders the identity the feed. The feed label describes the contents of the sack or package and the growth stage for which it is intended. Details of what will be accomplished for packaging and labelling of finished feed will include:

Bagging:
The sack-off operator will check and clean all equipment before bagging; Scales will be tested for accuracy, including bag tare; Verify bags and/or tags will properly coded for the day’s run; At the beginning and throughout every run, bags will be periodically check-weighed; and all scales will be certified annually.

Warehousing:
Up to this point in feed production great care has been taken in the manufacturing and materials handling of aquafeeds. Similar care will be taken in the warehousing of the final product. Sacked feeds will be stored in the warehouse off the ground on pallets away from sunlight with approximately one third of a meter between pallets to assure good air circulation. Storage will always be on a first-in, first-out basis.

Storage of finished feeds will be carried out with the protection of the tilapia fish and human health as primary considerations. All bagged products which are shipped will be in good condition (no ripped or otherwise leaking bags).

Sampling methods and analyses:
Sampling of raw ingredients and the finished products of aquaculture feed milling will be conducted routinely so as to be certain that the raw materials going into the feed and the finished feed itself meet formula specifications.

**Ingredients:**
When bulk truck shipments are sampled, samples will be taken from the beginning, middle and end of the discharge stream. Ingredients will be periodically tested when or if pesticides or other toxicants are suspected, and, in some instances, the product will be checked microscopically. Sampling to determine whether ingredients meet specifications may be necessary if there is any doubt about the quality of goods received. All samples of ingredients and finished product will be well-preserved and protected against destruction (rodents, insects, etc.), deterioration (moisture, mould, etc.) or adulteration.

**Finished Feeds:**
Every production run, bag feed or bulk, will be physically inspected for colour, odour, texture, and moisture (when appropriate). Samples of bagged production runs will be taken periodically. All subsamples will be placed in a large container, mixed, and approximately 1/4 to 1/2 kilogram placed in an appropriate container. Bagged production run samples will be identified with a properly coded tag. The production manager will determine appropriate tests and be responsible for evaluating the results.

**RECALLING DEFECTIVE OR MISLABELED PRODUCT**
Yalelo will use a broad range of ingredients, and a product recall may be necessary because of quality or labelling error. In that case, a product recall procedure involving products manufactured by the mill will be put in place.

**Personnel**
Aquafeeds will be made by knowledgeable and trained personnel. Every employee from top management on down will have a working knowledge of the mill and the various specialties required to produce a finished product.

**Documentation**
Documentation is of prime necessity in quality assurance and traceability procedures according to critical control points in the manufacturing process and quality control. All personnel shall be drilled in all the necessary details and procedures to permit investigation and traceability of products at all times.

The system of documentation will be such that the history of each batch, blend, or run of product may be determined. Documentation will be both adequate and systematic and relate both to the manufacturing process and to quality assurance. All relevant documents including those referring to quality assurance or HACCP procedures will be retained for an appropriate amount of time, or as required by Zambian regulations.
5.3.5 Promotion of Small-holder “Out-grower” Fish Farming

The National Aquaculture Strategy of Zambia considers the development of contractual partnerships between small scale fish farmers and commercial aquaculture companies such as for cage aquaculture as a key criteria to increasing national aquaculture development. By forging such a relationship smallholder fish farmers benefit through access to markets, feed, seed and capital.

Currently, there is little smallholder fish cage aquaculture around Lake Kariba. This is predominately because the community lacks technical know-how and capital. Furthermore, these limitations are compounded by lack of a reliable source of high quality fingerlings, affordable and high quality fish-feed, good quality and affordable cages and difficulties of access to markets. Yalelo Ltd is committed to development of aquaculture in Siavonga by promoting the development of smallholder fish cage aquaculture through contract fish farming (out-grower). The major advantages of such an outgrower scheme are that it:

- Provides farmers, who naturally would not have invested in cage aquaculture due to high capital requirements, opportunities to participate in the sector.
- Enhance marketing of products.
- Improve competitiveness in input supply, consistency in quality of inputs procured and allows small-scale operators to benefit from bulk purchase discounts.

Several out-grower models such as franchising, satellite model driven by processors and wholesalers, or cooperatives evolving from a mentorship programme are all practicable. Choice of model by Yalelo will be determined on a case by case basis. The Yalelo outgrower scheme will:

- improve livelihoods of community members living by Lake Kariba
- increase technical know-how through the transfer of sustainable aquaculture skills and technical knowledge of small-scale tilapia aquaculture production
- ensure a sustainable model for a continued out-grower scheme for community members

Each participating smallholder will receive aquaculture technical training and access high quality inputs for tilapia aquaculture. To contribute to women’s empowerment in the community at least 50% of participants shall be women.

5.3.6 Fish Sales

Yalelo Limited will develop ‘wholesale and distribution hubs’ in the major cities of Zambia (Lusaka, Ndola, Kitwe, Livingstone, Solwezi, and Lumwana) with smaller retail outlets in the largest cities. Lusaka will be the first market entered. From year three onwards the Company will develop wholesale relationships with distributors in neighbouring countries.
6.0 Materials

Yalelo Limited
Siavonga Site Plan

Siavonga (24km)

Hatchery Building

Laboratory, Processing and Workshops

Feed Mill

Water Treatment Ponds

Breeding Ponds

Holding Ponds

Grow-Out ponds

Entrance

To Lake Kariba (100m-550m)
Materials required for fish cage culture are fingerlings (young fish) for stocking in cages, materials for floating cage fabrication and fish feeds.

6.1 Hatchery
Yalelo will construct the leading tilapia hatchery in Southern Africa. The hatchery will be used to breed tilapia fish and produce “fingerlings” (young fish). Fingerlings will be used to stock Yalelo’s own lake-based grow-out cages and sold to small-holder farmers in the Lake Kariba area. Small-holder aquaculture has failed in the past due to the lack of a reliable supply of adequate inputs, primarily feed and fingerlings. The sale of fingerlings from Yalelo’s hatchery will facilitate an enabling environment for smallholder fish farmers, ultimately assisting in improving rural livelihoods.

Brood stock for production of fingerlings will be sourced from reputable hatcheries. A selective breeding programme will be implemented in accordance with Aquaculture Best Practice, in order to avoid in-breeding and ensure the health and growth performance of fingerling. No GMO fish will be used.

Nile Tilapia are asynchronous breeders therefore hormones are not necessary to induce spawning, which occurs naturally during the warm seasons. Breeding will be conducted in hapa (breeding nets for 4-8 individual fish) within breeding ponds that are supplied with river sand for soft substrate. Adult fish are held in Holding Ponds when not breeding in breeding ponds. An adequate time in holding ponds is necessary to ensure the welfare of fish and allow for recuperation between breeding sessions. Fry (newly hatched fish) will be collected between 14 to 18 days after introduction of broodstock to the breeding ponds. Ponds are drained and broodstock returned to the holding pond for resting after spawning. Chlorine and quick lime are used to disinfect the ponds before filling and beginning another breeding cycle.

Yalelo uses a stocking ratio of 1 male: 2 females in the breeding ponds. The breeding pond is stocked with between 150 –180kg of broodstock across several hapas and this is dependent on the size of the fish. Broodstock is fed at 1-2% of body weight and feed is reduced in the last week of the breeding cycle to minimize water fouling as response to feed is low when fish are incubating.

Sex-reversal
Commercial tilapia production generally requires the use of male monosex populations. Male tilapia grows approximately twice as fast as females. Therefore, mixed-sex populations develop a large size disparity among harvested fish, which affects marketability. It is therefore necessary to reverse the sex of female fry. This is possible because tilapia do become sexually differentiated for several days after yolk sac absorption. If female tilapia receives a male sex hormone (17α methyltestosterone, MT) in their feed, they will develop as phenotypic males.

Fry collected from breeding facilities need to be graded through 3.2 mm mesh material to remove fish that are >14 mm, which are too old for successful sex reversal. Swim-up fry are generally <9 mm. MT is added to a powdered commercial feed or powdered fish meal, containing >40 percent protein, by dissolving it in 95-100 percent ethanol, which is mixed with the feed to create a concentration of 60 mg MT/kg feed after the alcohol has evaporated. The alcohol carrier is usually added at 200 ml/kg feed and mixed thoroughly until all the feed is moist. The moist feed is air dried out of direct
sunlight, or stirred in a mixer until dried, and then stored under dark, dry conditions. Androgens break down when exposed to sunlight or high temperatures.

Fry are stocked at 3 000 to 4 000/m² in hapas or tanks with water exchange. Stocking densities as high as 2000/m² have been used if good water quality can be maintained. An initial feeding rate of 20-30 percent body weight per day is gradually decreased to 10-20 percent by the end of a 3 to 4 week sex-reversal period. Rations are adjusted daily, and feed is administered four or more times per day. If sex-reversal is conducted in hapas, the feed must be of a consistency that allows it to float. Otherwise a considerable amount of feed would be lost as it settles through the bottom of the hapa. Sex-reversed fry reach an average of 0.2 g after 3 weeks and 0.4 g after 4 weeks. The average efficacy of sex-reversal ranges from 95 to 100 percent depending on the intensity of management.

Yalelo will use locally bred Nile *Tilapia* for stocking in cages. The Nile Tilapia already exists in Lake Kariba. Yalelo will therefore not introduce a new species. The fingerlings to be stocked will be all male and sourced from established fish hatcheries in the initial years before establishing own breeding facility. Fingerlings reared for up to two months will be stocked for on growing to table sized fish of 300-400 grams in four months.

### 6.2 Cage Fabrication Materials

Cage components consist of frame, nets, floats, weights and ropes. Net materials will be high density polyethylene ("HDPE") and nylon. The mesh size of the net depends on the size of fish to be held. Yalelo will use predominately 10mm and 20mm ‘half-mesh’ size nets. 10mm mesh of 1.0mm yarn will be used to securely hold fish of under 50 grams in weight and to avoid their escape. Fish of over 50 grams will be secured using 20mm mesh nets of 2.5mm yarn. Larger mesh sizes are used when possible to allow for adequate water exchange. Yalelo will use two nets per cage at all times to avoid escape and predator attack. The outer net, which is always of a 2.5mm yarn or stronger, is called a ‘Predator Net’. The inner net, which is of an appropriate size to prevent the escape of fish being held, is called a ‘Bag Net’. Bird nets of large mesh size are used above the water surface to avoid stealing and injuring of fish by birds.

The cages to be deployed on Yalelo farm are HDPE cages based on the Norwegian technique that was firstly introduced into China and is now used universally. These cages are also used by Lake Harvest Ltd in Zimbabwe and in 15 years of their operation, none has ever been destroyed in rough weather on Lake Kariba. The cage facility consists of two net frames made of HDPE plastic pipes and brackets, two nets, and an anchoring system. The pipes, which provide buoyancy to the cage, consist of either 200mm or 250mm diameter HDPE pipe, depending on overall cage diameter (20 meters or 25 meters). One pipe provides sufficient buoyancy under normal circumstances and the second pipe added is a failsafe mechanism to avoid sinking. A further failsafe mechanism in the Yalelo design is to fill the pipes with Kaylite (expanded polystyrene), which avoids the pipes filling with water in the event of a crack, again maintaining buoyancy and avoiding sinking. The cage design is highly reliable in open lakes of 20-80 meter in depth.

### 6.3 Fish Feeds

In Zambia, the leading fish feed producer is Tiger Animal Feeds Ltd. closely followed by the National Milling Corporation Ltd. Table 3 presents the nutrient composition of the third party feeds currently used by Yalelo.
Table 6: Fish Feed Nutrient Budget

<table>
<thead>
<tr>
<th>Item</th>
<th>Tiger Animal Feeds</th>
<th>National Milling Corporation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phosphorous</td>
<td>0.8 - 1.2%</td>
<td>0.8% -1%</td>
</tr>
<tr>
<td>Nitrogen</td>
<td>3.5 %- 4.8%</td>
<td>3.5%-4.8%</td>
</tr>
<tr>
<td>Calcium</td>
<td>0.3% - 1%</td>
<td>0.3 -1%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Raw Materials</th>
<th>Maize</th>
<th>Soya bean meal</th>
<th>Wheat</th>
<th>Fishmeal</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>9-12%</td>
<td>40 -55%</td>
<td>5-10%</td>
<td>2-7%</td>
</tr>
</tbody>
</table>


Table 6 shows the nutrient composition of commercial floating fish feeds available in Zambia. The main element of interest in the nutrient budget is phosphorous and nitrogen because they can contribute most highly to eutrophication. The amount of phosphorous and nitrogen loaded into the Lake by way of uneaten feed and excreta are the determinants of environmental carrying capacity of any given water body. Consequently, the carrying capacity thresholds due to added enrichment with fish feeds vary with prevailing trophic state of the environment. For example, the safe feeding threshold for a nutrient-poor oligotrophic environment such as Lake Kariba will initially be higher than for a nutrient-rich eutrophic environment. Other factors influencing environmental capacity include water surface area, water depth, seasonal fluctuations, amount and seasonality of flow-through and other uses of the environment.

From Table 6 it can be deduced that for every tonne of fish feed produced, 10-12kg of phosphorous and 35-48 kg of nitrogen are added into the environment. However, according to Boyd and Green (1998) Nile tilapia contains 7.5 kg of phosphorous and 21.2 kg of nitrogen per tonne of fish. This means that only 2.5 kg of phosphorus and 20.3 kg of nitrogen will be discharged into the environment as excreta. Based on studies from manure loaded fish pond farming, where a given amount of phosphates results in eutrophication, it is possible to estimate an acceptable threshold within which the water quality of the Lake would remain unchanged on the basis of the phosphorous composition of feed fed to the fish. At 35 kg/m³, feed requirement at 2.5% of body weight is 0.875 kg per day. This means that at full production Yalelo will discharge about 72kg of phosphorous and 588.7kg of nitrogen per day. This is about 26% of phosphorous requirement to cause eutrophication. This means that Yalelo project is well within the Lake’s carrying capacity.

In addition to feeds, a small quantity of ordinary coarse salt will be added to sanitize the fish in the event of injury or bruises due to overcrowding. In relation to the Lake water, the amount of salt required to clean the fish is much too small to have an effect beyond the cage itself. Even within the cage, the change in water quality is temporal as the salt is quickly diluted through water exchange. However, the project implementation will be accompanied by water quality monitoring programme which will include periodic estimates of phosphorous, nitrates and ionic composition of the water.

6.4 Products and by-products

The farm will initially sell whole fish for eating, intended for human consumption. These will be fresh and frozen. Within 24 months, a fish processing facility will skin, gut and fillet fish. This process will produce by-products. By-products such as skins which will be recovered for production omega-3 rich fish oil for human consumption. By-products such as heads, scales, bones and gut will be converted into fertilizers. Fat and gut will be sold as a valuable product for use in the production of animal feed by the domestic Zambian animal feed industry. Therefore, no fish wastes from processing will be released into the surrounding ecosystem. The factory will employ a “closed loop” technique.

Please see section 9.2.2.1 for detailed information on the treatment of processing factory effluent treatment.

Table 7: Estimation of Tilapia Process Waste Composition

<table>
<thead>
<tr>
<th>Type of Waste</th>
<th>Tonnes</th>
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</thead>
<tbody>
<tr>
<td>Heads</td>
<td>1,085.8</td>
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<tr>
<td>Blood and Viscera</td>
<td>56.7</td>
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<tr>
<td>Deboning wastes</td>
<td>612.6</td>
</tr>
<tr>
<td>Scales</td>
<td>160.0</td>
</tr>
<tr>
<td>Viscera</td>
<td>502.1</td>
</tr>
<tr>
<td>Skins</td>
<td>231.2</td>
</tr>
<tr>
<td>Total</td>
<td>2,648.4</td>
</tr>
</tbody>
</table>

Source: Calculated from Alfonso Delfin, E. Compounded Fish Meal Based on Tilapia Process Waste Tilapia Waste Based Fish Meal Rendering: www.worldwildlife.org/WWFBinaryitem5360.pdf

Out of the projected 7,000 tonnes of fish production, 4,000 and 3,000 tonnes will be gutted and filleted respectively per year. As a result, the farm will generate approximately 3,241.6 tonnes of gutted fish and 1,110 tonnes of fish fillets. The fish processing operation will generate approximately 2,600 tonnes of wastes for use in the production of fish meal and omega-3 oils.

The fish wastes, including mortalities, will be processed into fish meal and fish oil for use as feed for livestock such as poultry, pigs and farmed fish. Wastes will not be discharged into the environment. Waste water will be treated through a rendering plant to produce water which is within acceptable levels for release into the lake.
Figure 2: Flow Chart of the Production Process
7.0 Alternatives

The alternatives to the proposed project include culture sites, species, and culture systems, with and without floating cages.

7.1 Alternative 1: Cage culture site location

The most appropriate alternatives to fish cage culture in Zambia are also located within Lake Kariba. There is no water body in Zambia with more suitable conditions for cage culture than Lake Kariba. Other sites along Lake Kariba exist, but do not have better water quality conditions than zone 4 where Yalelo is developing the fish farm. The site that Yalelo has earmarked is in most suitable location for cage culture in the country. Other zones have relatively higher nutrient/sediments in water and therefore lower carrying capacity. Zone 3 is acceptable, but with limitations on depth due to higher average turbidity. This means that fish would be unable to see the feed below 4 metres from the surface. Zone 2 has a higher nutrient content and is therefore less suitable for cage culture. Cage culture is not recommended in this zone because of remoteness to markets and less favourable water quality conditions.

It is therefore recommended to develop the Kamimbi aquaculture farm by Yalelo in its current location.

7.2 Alternative 2: Without the Project

Aquaculture without floating cages is the ‘business as usual’ option. Current capture fisheries are not sustainable and have resulted in significant overfishing during the last 20 years. Over-fishing has contributed towards an ongoing decline in per-capital fish consumption and broad undernourishment of large sections of Zambia’s population. Fishing communities are becoming increasingly impoverished due to low catches, taking a step backwards in development. Imports of fish from China, India and Zimbabwe have increased to meet market demand, however this weakens Zambian food security, uses valuable foreign exchange and results in higher fish prices due to import and transport costs. If Yalelo is unable to develop its location on Lake Kariba, the most suitable available site for aquaculture in terms of natural conditions; water quality, temperature and proximity to urban markets, the fish market in Zambia will need to continue to import frozen fish from China, India and Thailand. Fish imports are estimated to be above 6,000 tons per annum and growing rapidly. This scenario is less favourable due to its negative impact on national development, bio-diversity, foreign exchange reserves and national food security.

7.3 Alternative 3: Cage Culture without Nile Tilapia Species

Nile Tilapia is the fish species of choice as it is the only proven fish species suitable for economical cage culture in Zambia is Nile Tilapia and is already established in the natural conditions of this Lake. The law prohibits translocation of species across watersheds which mean that at species level, there is no alternative water body for culture of Nile Tilapia in cages in Zambia. Nile Talipia fish are widespread in the wild within the lake.

However, other water bodies exist for possible cage culture of other fish species. In theory, the red breasted bream (Tilapia rendalli) and catfish (Clarias gariepinus) can also be reared in cages, but this alternative system has not been proven in Zambia and its economic viability is still questionable. The
business risks of large-scale production of an un-tested species would stop the development of this project despite. Using an alternative species on Lake Kariba has no environmental benefit.

### 7.4 Alternative 4: Fishpond Culture Option

The alternative to cage culture is to raise fish from ponds. If this option is taken, at least 350 hectares of land would be required for ponds to produce the planned output of 7,000 tons per year. However, the cage culture option will only take up about 11.6 ha of the surface of the Lake in terms of total areas, and 2.2 hectares in terms of cage area. Not only is it more costly to set up such an aquaculture operation with fishponds, it also comes with greater negative environmental consequences and costs for operations and decommissioning. Fishpond production is more suitable for small operations; such as fish hatcheries, nurseries and quarantine services. The planned fishpond development operation will be modest and limited to breeding and primary nursery services to support the needs of cage culture operation.

It is therefore advisable to choose fish cage culture rather than fishponds for intensive production operations. Fish growth rates are higher in open lake cages than in fishponds and fixed and variable costs are lower. Pond investment costs are three times higher per kg of output compared to floating lake cages, which would push up fish prices within Zambia. Fish ponds also have a lengthier and more costly decommissioning process, with higher environmental risks during decommissioning. Discharge of effluent from ponds is greater than in cages. For an oligotrophic environment like that of Kariba Lake, cage culture benefits wild fish through uneaten feeds and fisheries through increased biomass.

### 7.5 Recommendation

Kamimbi Bay, where Yalelo cages are to be placed, is one of the sites identified by the National Aquaculture Development Programme for promotion of floating cage aquaculture in Siavonga district. This is because initial cage operations that were set up in the area were established within Siavonga Township area. However, the area close to the Township is fraught with conflicts and pollution control risks. In order to reduce visual conflicts with Lakeshore tourism operations, the Local Authority and Fisheries Department agreed to identify sites where cage culture operations would be unfettered by other Lake users. Towards this end, seven sites were been identified for selection of the most suitable place(s) for situting the first and subsequent cage culture clusters. The exercise identified Macawwa, Munyama/Chilongo, Lotrie/Mpango, Gwena, and Kamimbi and Banana bays. Kamimbi is nearest to Siavonga, after Banana bay, which maybe too close to the Township area and could become crowded with planned investments.

There are therefore a number of locations within the lake that fish cages can be located. However, proximity to the Yalelo service centre for storage and administration is the main consideration for situating cages within 15 km radius from land site. Other alternative sites are not superior to those selected by Yalelo with respect to depth of water level, water exchange and proximity to service centre. Alternative sites would also be uneconomical for Yalelo and provide no additional environmental benefits.

By locating its operations in Kamimbi, Yalelo has positioned itself in the most suitable cage culture zone in Zambia. The development of the project in this area is appropriate in all aspects of natural conditions for cage culture and therefore deserves support.
8.0 Baseline Conditions

8.1 Socio-economic Conditions
The population of Siavonga District in 2010 was estimated at 67,988 people. Approximately 11,648 individuals (17%) live in the area along the lakeshore. The annual population growth rate is high at 4.6% and suggests a substantial rate of immigration from other parts of the country, mainly for fishing activities, despite prevalent overfishing and declining capture fishing yields. About 88% of this population lives in the rural areas, concentrating mainly along the Kafue, Zambezi and Lusitu Rivers. The population that is also concentrated along the Lakeshore of Lake Kariba is substantial.

The urban population is contained within two small Townships of Siavonga and Chirundu. The most populated area is Kariba ward, around Siavonga, followed by Chirundu ward. The least populated is Ibbwemunyama ward on the plateau margins with less than 1000 inhabitants. Nanyanga ward has the highest proportion of the population vulnerable to hunger followed by Ngo’mbe Illede with 90% and 80% of the population vulnerable to hunger respectively. Incidentally, the areas more vulnerable to hunger are located inland of the Lake and have since been hived off and are now part of the new district of Chirundu.

In Zambia, the management and promotion of agriculture (including aquaculture) is through farm blocks and agricultural camps. The Yalelo Fish Farm is located in Simamba farm block which includes approximately 1,325 agricultural households. Simamba has three agricultural camps. Bbakasa camp has 349 farmers, Gwenacamp has 433 and Simamba is the largest with 543 agricultural households. Yalelo Fish farm is in Simamba agricultural camp and specifically Kamimbi fishing camp. The community of Kamimbi is principally a fishing community of 67 families consisting of 49 fisher households and 18 agric-pastoralists. Total population of the village, inclusive of children is about 400 persons. Fishing is the main livelihood of the community.

According to Isaac Malasha, livelihood options in Siavonga revolve around fishing, cropping and livestock rearing. Fishing is the livelihood of the last option, while cropping is the penultimate and the livestock rearing is seen as the pathway out of poverty. Malasha cites a survey carried out by the Department of International Development in 2000 which reveals that 70% of household income is from livestock sales, above all, cattle, goats and sheep. Cash crops contribute 15% and the balance is from fishing related incomes. Cotton is the major cash crop, while food crops are grown for subsistence and consist of sorghum, millet and maize. There are about 2000 fishers on Lake Kariba. At least 15% of these hire labour, representing the commercial sector, while the rest are artisanal self-employed fishers. However, there has been no estimate of income from Kapenta and inshore fisheries of Siavonga district, even though other estimates based on District revenues indicate that fish is more important than tourism (45% from fish levies and 35% from Tourism related incomes).

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6 Chirundu has been separated from Siavonga district of Southern province by Presidential decree and is now attached to neighbouring Lusaka province. However the decree awaits delimitation.
7 Isaac Malasha (2008) Fisheries Co-management, Mobility and Poverty Alleviation in small-scale fishing: examples from Lake Kariba (Zambia)
As elsewhere within Zambia, the health status of the population of the project area is characterised by high prevalence of malaria, diarrhoea, respiratory infections and Schistosomiasis. HIV/AIDS prevalence rates in Siavonga district is 16% for persons aged 15-49, above the provincial rate of 15%. This is attributed to relatively high mobility rate due to fishing and tourism. These factors are associated with relatively higher levels of transactional sex. The HIV/AIDS prevalence rate among sex workers in Zambia is estimated at 64% as opposed to the national average rates of 13.5%.

8.2 Physiographic Environment

The Lake Kariba is Zambia’s first and largest man-made lake. It was created following the impoundment of Zambezi River at Kariba for generation of hydroelectricity for Zimbabwe and Zambia. The joint framework for the management of the Lake falls under the Zambezi River Authority, established by separately by Act of Parliament in Zambia and Zimbabwe.

Lake Kariba lies on 480 metres above sea level and is over 280 kilometres long and up to 40 kilometres in width. It covers an area of 5,580 square kilometres and its storage capacity is an immense 185 cubic kilometres. The mean depth of the lake is 29 meters; the maximum depth is 97 meters. The lake levels fluctuate annually from 1 to 5 m (mean = 2.9 m) as a function of inflowing floods between December and June and continuous drawdown through the turbines and spillage through the sluice gates, when that is necessary. Lake Kariba is one of the world’s largest man-made reservoirs and the largest in East and Southern African Region. Average temperature is 25°Celsius.


Because of the enormity of the mass of water the Lake contains, (approximately 180 pentagrams [200 billion tons]) the area is now more prone to seismicity in the seismically active region. Over 20 earthquakes of greater than 5 on the Richter scale have been recorded since construction. The Lake is on the East African Rift System of the Mid-Zambezi Valley and is generally associated with a

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network of faults. However, before the lake was formed, the earthquake intensity was very low and the magnitudes were low and below magnitude 4. There was a sudden increase in earthquake activity as the lake began to fill, which was due to the extra weight of the volume of water being impounded on a restricted part of the earth’s surface. Thus the ground had to adjust to this additional weight by what is known as Reservoir Induced Seismicity (RIS) A correlation of lake levels and earthquake activity shows that there is a gradual increase in the number of earthquakes, when lake levels drop and vice versa. A time series analysis shows that the frequency of such an earthquake for Lake Kariba is within the time frame of the dam life. The probability of an earthquake of magnitude 6 is every 38 to 40 years, and an earthquake of magnitude 5.5 is every 20 years, whereas earthquakes of magnitude 5 are expected to occur every five years⁹.

Figure 3: Sketch Map of Lake Kariba Indicating Water Quality Zones

Since its creation, fishing has contributed 45% and tourism 30% to the local communities’ income, whereas the revenue for power generation goes to the two countries of Zambia and Zimbabwe.

8.3 Terrestrial Environment
The impoundment at Kariba pushed the land-water interface to the *Colophospermum mopane* woodland. The predominant vegetation of the site is of mixed species layered dry forest (Jesse bush) and mainly consists of *Colophospermum* woodland.

This is predominantly *Acacia albida*-dominated woodland that has however been thinned out due to previous human and livestock impacts and is better described as mixed *Acacia albida* / *Combretum imberbe* / *Kigelia africana* / *Loncocarpus capassa* woodland with isolated stands of *acacia albida* and thick herbaceous understorey of senkenene (*Paspalum paspaloides*). The upper part of the Yalelo farm property consists of degenerated *colophospermum* / *Kirkia* / *Terminalia* woodland and grassland on the bottom close to shore. The species composition of each of these vegetation types is described in Du Toit (1982)\(^{10}\).

8.4 Climate
There are only three "seasons" on Lake Kariba, "WET", "COOL" and "HOT". The "Wet Season" starts in late November or in December with intense thunderstorms. In January and February, the Inter Tropical Convergence Zone drifts down to Zambia and the whole of the Zambezi Valley experiences continuous heavy rain, overcast skies and thunderstorms, interrupted by lovely clear mornings. In March, the ITCZ moves north again, usually wetting Kariba on its way!

Rainfall around Lake Kariba is erratic and low. Mean seasonal rainfall varies from 680 mm to 950 mm, but can be as low as 356 mm and as high as 1299 mm in some years. The unreliability of rainfall in this area is illustrated by three forms of drought; from April to October; frequent dry spells in the rainy season and conventional droughts of low seasonal rainfall as indicated above.

The second season is the Valley's cool "winter" months of May to August. Temperatures fall to about 10° Centigrade in June and July. Generally, night-time temperatures during this time are 15 °C and rising to 25 °C during the day. Days and nights are clear and the surface wind is generally light and predictable.

The “third season” creeps up on Kariba with the days getting progressively warmer and longer. October is hot and dry. Daytime temperatures build up to 40 °C dropping to 30 °C at night. In November the chance of rain improves and the trees push out their new buds to lie in wait for the first rains.

Air temperatures are usually above 20° C, but have a distinct seasonal variation. Maximum temperatures are in October and November when mean monthly maximum is 33-38 °C and absolute maximum of 41 °C and gradually decrease during the rains to a minimum in June/July mean monthly maximum of 13 °C and an absolute minimum of 3 °C. Daily hours of sunshine vary from a mid rainy season low of 6.4 hours to a winter high of 10.1 hours.

The winds are generally easterly although there is a northerly at the onset of the rains. The easterly breeze can deteriorate into a storm, locally known as Sanyati and a south-westerly known as Sinazongwe. The onset of the rains sees the highest mean winds which average 6 knots in October as compared to the mean wind speeds of 3 to 4 knots for most of the year. However, gusts of 25 and 40 knots have been experienced when pressure is rising and during thunderstorms. Wind speeds of up to 90 knots associated with thunder squalls have also been recorded. However these would be short lived (up to an hour) and are likely to be limited to a small fetch (20 km maximum). Their wave generating potential is therefore limited with significant wave heights not exceeding 2 metres. Of

greater concern are winds that are sustained for 12 hours or more. These winds occasionally exceed 20 knots and generate waves of 1.6 metres. A sustained wind speed of 30 knots is likely to occur once a year and can generate waves of 2.4 metres. It is estimated that a wind of 40 knots will occur once in 10 years and 50 knots or more once in 50 years. These estimates are backed by anecdotal evidence indicating that wind speeds of 90 knots were recorded in 1974.\footnote{Pers. Comm. with Gladys Petersen – Lake Harvesters Ltd}

8.5 Fauna

Baboons and monkeys are some of the more easily seen primates along the Zambezi valley. They can be seen along the roads and the shoreline as they troop to feeding in the morning and retiring to sleep in the afternoon. Crocodiles are found throughout the lake, although predominately in shallow areas. Human death due to crocodile attack is quite frequent, especially when cleaning or washing by the lakeshore. The Yalero EHS Policy provides guidelines for Employees on minimizing crocodile attacks. Lake Kariba is infested with crocodiles also because the many crocodile farmers there are required to release 10 percent of their new stocks annually. This has heightened human wildlife conflicts especially among fishers.

There is not much information about many of the bird species associated with the lake. Apart from some information on the reed cormorant (\textit{Phalacrocorax africanus}) and the darter (\textit{Anhinga rufa}) by Birkhead (1978), there seem to be little available. Both species have a similar diet with cichlids representing over 90% by numbers and 70% by weight\footnote{Birkhead, M.E., (1978) Some aspects of the feeding ecology of the Reed Cormorant and Darter on Lake Kariba, Rhodesia. \textit{Ostrich}, 49:1–7}. It has been estimated that approximately 6.4 tonnes of fish are taken per year from a 5km stretch of shoreline by 4.59 tonnes of cormorants and 1.82 tonnes of darters. Junor (1972) estimated the mean daily consumption for various cormorants to be 10–14% of their body weight\footnote{Junor, F.J.R., (1972) Offshore fishing by the pied kingfisher (\textit{Ceryle rudis}) in Lake Kariba. \textit{Ostrich} 43:185}. Both \textit{P. africanus} and \textit{A. rufa} feed in the littoral areas of the lake which have a mean depth of 2m. Apparently this is the area where maximum density of fish occurs.

The other piscivorous birds in the lake are \textit{Haliaeetus vocifer} (fish eagle), \textit{Ardea goliath} (goliath heron), \textit{Ceryle rudis} (pied kingfisher) and \textit{Milvus migrans parasitus} (yellow-billed kite). There seems to be no quantitative data on these species. The above species are primarily inshore predators though \textit{C. rudis} and \textit{Chlidonias leucopterus} (whitewinged black tern) also prey upon the largely pelagic Kapenta (\textit{Limnothrissae. miodon}) (Junor, 1972; Begg, 1973)\footnote{Begg, G.W. (1973) The feeding habits of the whitewinged black tern on Lake Kariba \textit{Ostrich}, 44:149–53}.

There are no indications that the Yalelo project site is being used for breeding or as animal migration route. The site is therefore free of wildlife and the planned development will not in any way affect animal welfare.

8.6 Aquatic Environment

From water quality and fisheries management perspective, the lake is divided into 4 zones in Zambia and 5 zones in Zimbabwe. Zone 1 is upstream starting at Namazambwe after the river leaves the gorges and forms the Lake reservoir to Sinazongwe. Zone 2 starts from Sinazongwe and ends at Chezyo River. Zone 3 extends to Lufua River. Zones 1 and 2 have riverine conditions. Zone 3 has
intermediate characteristics (mesotrophic) while zone 4 from Lufua River to the Kariba Gorge at the Dam wall shows typical lacustrine characteristics. Siavonga sector of the Lake, where the Yalelo farm is located, is in zone 4. Water stays long enough here to be similar to natural lake conditions, whereas in zone 1 and 2, the water residence is annual, thereby resembling riverine conditions. Thus, the obvious upstream impact of Kariba Dam was to change from riverine habitat to a lacustrine habitat. This has implications on the physical, chemical and biological attributes of the “new” habitat.

Lake Water has evolved from an initial high-medium nutrient (eutrophic/mesotrophic) status to the current poor nutrient (oligotrophic) status. There are signs of localized mesotrophic/eutrophic conditions in zone 1 and 2 and areas receiving anthropogenic nutrient inputs, such as Kanyelele cove in Siavonga Township. Phosphorus is the limiting nutrient to biological productivity.

The volume of Lake Kariba at full capacity is 177 million tonnes. About 80% of the water entering the Lake is from inflowing Zambezi River and 14% is from small rivers flowing into the Lake and the balance being from rainfall. The total residence period is 3 years.

According to physicochemical composition of water obtained from zone 4 sites, pH at various depths is on average 7.4 which indicates that water quality is neutral. Secchi disk reading is a 6, indicating that the Lake is oligotrophic. Water temperature is generally 25°C or higher. The water quality characteristics indicate that the natural conditions of the Lake are suitable for aquaculture.

### Table 8: Physicochemical Parameters (µg/L) of Water – Without Cages

<table>
<thead>
<tr>
<th>Site</th>
<th>Depth</th>
<th>Secchi</th>
<th>Temp</th>
<th>pH</th>
<th>Conductivity</th>
<th>NTU</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>0</td>
<td>2.5</td>
<td>27.6</td>
<td>7.62</td>
<td>94.3</td>
<td>2</td>
</tr>
<tr>
<td>16°34'457E</td>
<td>5</td>
<td>6</td>
<td>27.4</td>
<td>7.73</td>
<td>94.6</td>
<td>1.9</td>
</tr>
<tr>
<td>028°48'608S</td>
<td>10</td>
<td>0</td>
<td>24.5</td>
<td>7.57</td>
<td>91.8</td>
<td>2</td>
</tr>
<tr>
<td>AT=34</td>
<td>15</td>
<td>0</td>
<td>24.1</td>
<td>7.21</td>
<td>90.3</td>
<td>3.3</td>
</tr>
</tbody>
</table>


Similarly, the nutrient composition of water, oxygen, nitrogen and phosphorous indicated in Table 6 shows that the zone has oligotrophic conditions and is therefore very good for fish cage culture.

### Table 9: Water Chemistry (Nutrient µg/L)

<table>
<thead>
<tr>
<th>Item</th>
<th>Parameters</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phosphorous</td>
<td>6.4 µg L⁻¹</td>
</tr>
<tr>
<td>Nitrate</td>
<td>15 µg L⁻¹</td>
</tr>
<tr>
<td>Conductivity</td>
<td>118.2 µS cm⁻¹</td>
</tr>
<tr>
<td>Dissolved oxygen</td>
<td>7.9 mgl⁻¹</td>
</tr>
<tr>
<td>Ph</td>
<td>7.4</td>
</tr>
<tr>
<td>Temperature</td>
<td>28.5°C</td>
</tr>
<tr>
<td>Secchi depth</td>
<td>4.5 to 5.8m</td>
</tr>
</tbody>
</table>

Source: Yalelo EIA Baseline Assessment, March 11, 2012

The creation of Lake has favoured the development of a phytoplankton community. Following the closure of the dam in 1958, blooms of cyanobacteria, Microsystis species were also observed in 1959.
(Mitchell, 1969). Thomasson (1981) records a total of 156 species from the entire lake while Ramberg (1987) records 82 species from the Sanyati basin (zone 4) only. In both studies, Chlorophyceae (the Green Algae) are the most dominant in terms of number of species.

### 8.7 Fisheries resources

Machena (1995) addressed the fisheries of Lake Kariba (Zambia/Zimbabwe). Yields are 30-57 kg/ha/year\(^{15}\). This is very low. And if *Limothrissa miodon*, Kapenta is excluded, the yields of inshore fisheries are even lower. This is because Lake Kariba is an oligotrophic system with low fish production potential (limited by nitrogen and phosphorus).

**Table 10: Standing stock of major fish species (ie. >1%) in Lake Kariba (from Marshall, 1984)**

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>kg ha(^{-1})</td>
<td>%</td>
<td>kg ha(^{-1})</td>
</tr>
<tr>
<td>1 <em>Mormyrops deliciosus</em></td>
<td>92</td>
<td>15.1</td>
<td>126</td>
</tr>
<tr>
<td>2 <em>Hippopotamyrus discorhyncus</em></td>
<td>96</td>
<td>15.9</td>
<td>70</td>
</tr>
<tr>
<td>3 <em>Marcusenius macrolepidotus</em></td>
<td>8</td>
<td>1.8</td>
<td></td>
</tr>
<tr>
<td>4 <em>Mormyrus longirostris</em></td>
<td>18</td>
<td>3</td>
<td>45</td>
</tr>
<tr>
<td>5 <em>Hydrocynus vittatus</em></td>
<td>31</td>
<td>5.1</td>
<td>10</td>
</tr>
<tr>
<td>6 <em>Brycinus lateralis</em></td>
<td>29</td>
<td>4.8</td>
<td>6</td>
</tr>
<tr>
<td>7 <em>Brycinus imberi</em></td>
<td>13</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>8 <em>Labeo altivelis</em></td>
<td>6</td>
<td>1</td>
<td>53</td>
</tr>
<tr>
<td>9 <em>Eutropius depressirostris</em></td>
<td>9</td>
<td>1.5</td>
<td></td>
</tr>
<tr>
<td>10 <em>Clarias gariepinus</em></td>
<td>52</td>
<td>8.6</td>
<td>13</td>
</tr>
<tr>
<td>11 <em>Heterobranchus longifilis</em></td>
<td>14</td>
<td>2.3</td>
<td>7</td>
</tr>
<tr>
<td>12 <em>Malapterurus electricus</em></td>
<td>48</td>
<td>8</td>
<td>10</td>
</tr>
<tr>
<td>13 <em>Serranochromis codringtoni</em></td>
<td>13</td>
<td>2.2</td>
<td>12</td>
</tr>
<tr>
<td>14 <em>S. macrocephalus</em></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15 <em>Pharyngochromis darlingi</em></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>16 <em>Oreochromus mortimeri</em></td>
<td>97</td>
<td>16.0</td>
<td>22</td>
</tr>
<tr>
<td>17 <em>Tilapia rendalli</em></td>
<td>56</td>
<td>9.3</td>
<td>53</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td>561</td>
<td>92.8</td>
<td>382</td>
</tr>
</tbody>
</table>


Fish production is in shallow littoral areas. But the reservoir has steeply sloping shoreline. Crocodiles consume the equivalent of 10% of the annual catch of about 2,000 tons. Table 15 indicates that

catch composition is shifting toward benthic fishes, especially catfishes. The fishery is reported to be plagued by high catch spoilage and low productivity.\textsuperscript{16}

FAO Fishbase (annex 1), lists 38 species for Lake Kariba, but seems incomplete as it does not include Oreochromis niloticus introduced following escapes from fish culture ponds and probably cages on the Zimbabwe side. It does not list Procamanus clarkia which is also present in the Lake. Today, O. niloticus is reported to be predominant in gill net catches than other cichlids. Balon (1974) however lists 40 species and classifies these according to their commercial status. He identifies 13 ‘economically’ important species, of which Mormyrus longirostris and Mormyrus deliciosus, Hydrocynus vittatus, O. mortimeri, Tilapia rendalli and Clarias gariepinus as significant and 12 ‘secondary’ species of which Limothrisa miodon and Hipopotamyus discorynchus as significant ones in this category and further lists 15 ‘accompanying’ species, of which, Alestes lateralis and Haplochromis darlingi are pronounced. He concludes from this list that the first 9 of the economically preferred and first 6 in secondary and first 5 of the accompanying species form 97% of the standing stock. It is clear that record of fish classifications of the Kariba warrants updating in view of changes; introductions and extinctions. For example, O. mortimeri has hybridised with O. niloticus and is probably now extinct.

According to results of gillnet sampling exercise carried out for this study from Kamimbi, Gwena and Eagle’s Nest in Siavonga at locations exceeding 15 metres in depth, only eight species were recorded, Hydrocynus vittatus, Brycinus imberi, Schilbe intermedius, Tilapia sparmani, Pseudocrenilabrus philander, Synodontas nebulosus and Serranochromis macrocephalus. Evidently, only one of them, Hydrocynus vittatus, is economically significant. This confirms that fish is more abundant in areas close to the shoreline as noted by studies cited in Table 15. Figure 4 shows the locations of the biomass sampling stations.

Figure 4: Biomass Sampling Locations
8.7.1 Aquaculture Species

The commonly used indigenous species in aquaculture include the three-spotted bream (*Oreochromis andersonii*), the Green-headed bream (*Oreochromis macrochir*), and the Red-breasted bream (*Tilapia rendalli*). Nile Tilapia (*Oreochromis niloticus*), introduced to the lake over 15 years ago, is especially preferred in for aquaculture because of its ability to tolerate crowding, disease resistance and adaptation to a wide range of diets. Appearance and taste of Nile Tilapia are acceptable to consumers as it is not very different from native breams. There has been no attempt to culture indigenous fishes in cages; therefore their suitability for cage culture is not proven. Until then, Nile tilapia remains the fish culture species of choice in cages. But this implies restriction of fish cage culture operations in Zambia to Lake Kariba, where it is already established. Several hatcheries throughout Zambia supply Nile Tilapia fingerlings to the market.
9.0 Project Impacts

The impacts between aquaculture and environment are in both directions. Fish cages have an impact on the environment and the environment also has impacts on floating cage aquaculture. This section presents these impacts and mitigation measures of environmental factors on floating cage aquaculture and floating cage aquaculture on the environment.

9.1 Socio-economic impacts

Socio-economic impacts are “the consequences to human populations of any public or private actions that alter the ways in which people live, work, play, relate to one another, organize to meet their needs, and generally cope as members of society. The term also includes cultural impacts involving changes to the norms, values, and beliefs that guide and rationalize their cognition of themselves and their society.” Social Impacts can be both positive and negative. They affect the following areas: employment, income, production, way of life, culture, community, political systems, environment, health and well-being, personal and property rights, and fears and aspirations. In short, a social impact is a significant improvement or deterioration in people’s well-being.

Projects affect different groups differently. Some people tend to benefit while others may lose. Historically, impacts are particularly severe for vulnerable groups, for example, tribal people, women-headed households, elderly persons, landless persons, and the poor.

The development of the Yalelo project has a number of impacts on the community. Positive impacts include increased employment for over 200 rural households, improved livelihoods, and improved healthcare for employees, employment of women and venerable groups and increased economic activity for local business supplying Yalelo. In order to allow for suitable, safe and cooperative land and business development there are also impacts involving voluntary displacement of seven households, protection of a children’s cemetery; protection of the shoreline gardening activities and loss of previously open access pasture land. These impacts have been mitigated to minimise their impact. The mitigation measures are described in detail below.

9.1.1 Loss of dwellings and other farm buildings

In order to enable safe development of the Yalelo farm and associated infrastructure and services, as well as to comply with Town and Country Planning Land Use Regulations, it is necessary to displace seven resident families from parts of Yalelo’s farm. A public meeting was held on 12th May 2012 in Kamimbi Village to discuss:

1. Re-settlement of the families whose huts and livestock pens are positioned in Yalelo farmland
2. Protection of a children’s cemetery
3. Mutual agreement on fencing and shoreline activities.

Full signed minutes, a signed attendee list and photographs are available in the appendix of this report.
In summary, the meeting was informed that Yalelo would like to agree on an outcome which did not unwillingly displace individuals living on the land alienated to Yalelo. The meeting called on Yalelo to facilitate resolution of this matter as soon as possible and willingly assist whosoever is in need of assistance. The meeting recognised the affected households as being represented by the following persons:

i. Mr. Alfred Simungulu and his adult children,  
   1. Richard Simungulu  
   2. Abedinego Simungulu  
   3. Assizzio Simungulu  
   4. Anteugoes Simungulu  
   5. Abed Simungulu  

ii. Webster Matiya  

iii. Amos Gasa and  

iv. Charles Muleya.

It was confirmed that the above individuals are located on the farm through a comprehensive physical search of the plot and interview of local residents. The individuals living on the land themselves independently proposed and requested they be paid relocation compensation and be given assistance in voluntarily moving to land off the Yalelo plot but still nearby. Yalelo agreed that that was a suitable agreement and that Yalelo would be happy to agree to their terms. The amounts of financial assistance requested and date that each individual requested to move were:

<table>
<thead>
<tr>
<th>Name of Beneficiary</th>
<th>Amount</th>
<th>Date of Moving</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Alfred Simungulu</td>
<td>K1,500,000</td>
<td>September, 30 2012</td>
</tr>
<tr>
<td>2. Abed Simungulu</td>
<td>K1,500,000</td>
<td>September, 30 2012</td>
</tr>
<tr>
<td>3. Anteugoes Simungulu</td>
<td>K1,500,000</td>
<td>September, 30 2012</td>
</tr>
<tr>
<td>4. Abedinego Simungulu</td>
<td>K3,000,000</td>
<td>September, 30 2012</td>
</tr>
<tr>
<td>5. Charles Muleya</td>
<td>K3,000,000</td>
<td>September, 30 2012</td>
</tr>
<tr>
<td>6. Assizzio Simungulu</td>
<td>K2,000,000</td>
<td>September, 30 2012</td>
</tr>
<tr>
<td>7. Richard Simungulu</td>
<td>K2,000,000</td>
<td>September, 30 2012</td>
</tr>
<tr>
<td>8. Amos Gasa</td>
<td>K2,000,000</td>
<td>October, 30 2012</td>
</tr>
<tr>
<td>9. Webster Matiya</td>
<td>K1,700,000</td>
<td>November, 30 2012</td>
</tr>
</tbody>
</table>

**Total**  
K18,200,000

Yalelo reminded the individuals that there was no hurry to move and that the company would provide any further assistance required (e.g. moving roofing sheets or household items in a company van). There were no issues of payment being squandered by male-headed households as payment was agreed individually with each person and not at a household level.

9.1.2 Protection of Burial Space

A termite hill on the edge of Yalelo’s property is used for the disposal of still-born babies and placentas. We refer to this as the “Children’s Burial Site”. A new planned government road (not yet

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17 For details of the legal framework of resettlement and application of the resettlement principles see appendix 3:
built, and not instructed by or involving Yalelo) is expected to be built through the burial mound in the next two years. Regardless, it was agreed that Yalelo would fence off the cemetery to protect it and as a sign of respect. Yalelo assured the residents meeting that no development would take place beside the cemetery and that Yalelo would not interfere with the site (except building the protective fence for the benefit of local residents). Unrelated to Yalelo’s activities, local residents took the opportunity to discuss finding an alternative site, given the probability of the new road. Yalelo assured that to the best of its ability if would ensure all persons would have free access to the new burial mound, if the residents chose to move it, regardless of status, residence or ethnicity, if access was required via its land. The cemetery has therefore been adequately protected and left undisturbed. The burial mound is likely to be further mitigated if the community independently chose to open of an alternative site due to the government road construction.

9.1.3 Changes in Agro-Production Systems

There are two families that are involved in gardening of the lake front facing Yalelo’s plot. These are the families of Mrs. Lontiya Muleya and Mr. Justin Matiya. It was agreed that the use of the lakeshore should accommodate both smallholder activities and Yalelo activities, as the land in question is open to all lakeshore users as per government regulation. Yalelo will make absolutely no attempt to block access to the first 100 meters of lakeshore land (measured from the high water mark). It was also agreed that all of those involved should respect every user’s rights and avoid interferences. Yalelo will seek to minimise company activities on the 100m of lakeshore land, wherever possible. Residents suggested, and Yalelo agreed, the opening of dedicated facilities and site on the lakeshore for activities such as washing and cleaning by residents in order to retain in as much as possible the sanitary health of the area. This will consist of a paved area, foot pumps and washing blocks.

To accommodate access to lake shore by domesticated and wild animals, Yalelo and the community have agreed that fencing within its plot will be minimal and only be applied to those installations requiring security and safety of persons and property. The local residents urged Yalelo to provide adequate security and fencing because innocent local residents would not want to be implicated in thefts conducted by outsiders. At the same time, the meeting agreed that fencing should not be pursued wantonly and for its own sake as the area was occasionally also being used by game animals and humans for their own needs. Parties resolved that only critical areas requiring fencing for security and safety would be fenced so that other lake users are not severely affected. Overall the impacts of Yalelo farm development on other lake users and agro-pastoralists are minimal.

The project does not have an impact on family cohesion. In fact it has a positive impact on social support systems underlying family cohesion through increased market for local products, particularly fish, poultry and livestock to Yalelo employees who will have increased income.

9.1.4 Impact on Agricultural Lands

The project has a minimum loss on agricultural lands. The plot of 110 ha acquired for the purposes of fish farming activities is insignificant in relation to available open land within the area, and much of the plot will not be fenced, allowing continued free access by animals and humans. Most of the households are fishers and therefore do not require much land and pastoral families still have ample space for their livestock because they do not control their stocks through herding or other means of
controlled grazing. Livestock are set free to move as they please due to ample land availability and absence of cropping in the vicinity of pastures and browse.

9.1.5 Impact on Access to Common Property Resources
The common property resources involved are 1) the lakeshore area 2) access to the lake and 3) the burial mound. Access to the burial mound has been discussed above. On the lakeshore Yalelo has erected a 30 meters long, 10 meters wide and 2 meters deep access ramp for boats to enter the Lake. The ramp has minimum negative effect because of its size (10 meters wide) and because it can be used freely by other lake users, improving access. The ramp has positive impacts on lake users because the shoreline here is shallow, with an approximately 1% gradient. Boats struggle to reach the shoreline, especially when the water level is high, except canoes and at risk of crocodile attacks in shallow areas. The ramp will minimise this danger and at the same time afford easy access to the Lake. Access to the lakeshore area will not be blocked due to the minimal fencing on Yalelo’s plot, an open gravel road to the lake on the plot for public use, and free access through the neighbouring plot of Kamimbi Village. Because the project has no provision for enclosure of the shoreline, the proposed project will not affect access to common property resources.

9.1.6 Impacts on local businesses and employment

Impacts on Local Small-Holder Fishers
The establishment of a cage operation has broadly positive impacts on other businesses and jobs. The impact and competition with local fishers is low. Local fishers mostly operate from shallow areas, while the Yalelo cages are located into deep areas. At the request of local stakeholders in the Yalelo Community Consultation meeting of 16th January 2012, Yalelo will not sell fish into the local Siavonga market. Local fishers were concerned this would decrease prices and reduce demand for their fish. Yalelo has happily agreed that it will not sell its fish within the Siavonga area. There are therefore no positive or negative impacts in this respect.

Impacts on Kapenta Fishers
There is more potential for competition for lake space is between cages and Kapenta rigs, which areas also prefer deeper areas. Kapenta fishing is one of the largest sources of employment on the lake. However, because of the small amount of space taken by cages, it is unlikely that Kapenta fishing would be negatively affected by the new development. The total surface area to be covered by cages is 22,134m$^2$, which is 0.022 square kilometres. Lake Kariba has a surface area of 5400 square kilometres; therefore the proposed cages will cover less than one fifty-thousandth of the lake surface. As a result, kapenta vessels experience a very minimal decrease in available fishing area. A second consideration with respect to Kapenta is that uneaten aquaculture foods from Yalelo floating cages, may encourage plankton growth. Plankton growth in turn would encourage Kapenta growth, increasing catches for local Kapenta fishers. This is a positive impact of the project. However, it is expected that Kapenta rigs will operate further away from cages and may not catch these extra fish, leaving the current situation unchanged. Lastly, Kapenta rigs are noisy, which is a negative impact for Yalelo as may stress the fish in its floating cages. However, Yalelo expects this impact to be quite low.
**Impacts on Tourism**

The second most important economic activity on Lake Kariba is tourism. Tourism operators consider fish cages as unsightly, that they spoil the scenic views of the Lake. Tourism for example boat cruises and water-sports, are centred around the Siavonga town area and do not reach to Kamimbi. Therefore the location of the project in Kamimbi, where there is little or no tourism activity, should result in the project having no impact on tourism activities. “Visual aesthetic pollution” is therefore not an issue. However, because of the innovative nature of the operations, fish cage culture can actually be a positive tourism destination for educational, business and scientific visitors.

This process will be managed through an open and ongoing dialogue with tourism operators in the area on how to avoid any potential conflicts of the shared resource. For example, following dialogue, cages will be not be placed in locations where they may interfere with tourism. Yalelo will in fact be able to assist local tourism operators by organising controlled and safe tours of cage sites for boat tours, thus providing additional revenue for tourism operators. Furthermore, visiting senior management and international investors have and will continue to consume the services of tourism operators, e.g. lodging, restaurant meals and watersports.

**Impact on Employment**

Yalelo has a large positive impact for employment within the local areas. The company currently employs 40 individuals from surrounding villages and this number will grow to over 250 upon completion of project implementation. Women will hold an above average proportion of these jobs, with expectations of over 50 female employees upon expansion. A large majority of employees will be from vulnerable groups, namely rural communities.

**Impact on Local Suppliers**

Within Kamimbi and Namachembele communities, the economic impact of fish cage culture project on local business activities is positive and immediate. The presence of better paid workers creates a good market for local suppliers such as fish mongers and local food sellers. This may cause local prices to increase initially, however revenue generated by sellers will then enable investment in supply, bringing prices down again. Furthermore, the incomes spent by Yalelo employees will enable a ‘trickle-down’ effect, whereby the local vendors will also have increased income, which they will spend with other local vendors thereby reinforcing a virtuous cycle of economic growth. It is also normal for the amount of a good produced to increase when prices increase. This investment will create further local jobs and improved conditions for local businesses. In an environment where land or resources are constrained, the local population with its newly increased income could exceed the carrying capacity of the local economy. This would result in those at the bottom of the economic ladder experiencing lower purchasing power parity, i.e. less ability to buy new more highly priced goods. However, given goods can be transported from surrounding areas, price increases cannot be too high. Furthermore, the Siavonga area has a high carrying capacity due to its abundance of natural resources and labour. Higher incomes and income from local businesses will enable investment to make these economic factors more productive, supplying the local market comfortably at initial prices but higher per capita incomes.
The opening up of employment opportunities for unskilled persons by the project has a positive economic impact capable of eroding potential for despondency and dejection within the community. The employment and business opportunities due to the project exceed available labour supplies within Kamimbi area and Simamba Ward. Provided that each person can find a niche, the expected benefits go beyond immediate locality of Simamba Ward and Kamimbi. For example, there are only 49 fisher households in Kamimbi. Yalelo intends to recruit 50 smallholder fish cage farmers on an out-grower pilot, before increasing the size programme to significantly larger. Clearly, the capacity required goes beyond Simamba Farm Block where there are only 543 households, to Gwena and beyond, to attain the desired population of smallholder cage fish farmers. The project does not only bring with it economic benefits; it is also socially beneficial because tilapia aquaculture is more sustainable than fishing. This is because capture fishing in Lake Kariba exceeds the reproductive capacity of the lake, which is critically decreasing fish populations and resulting in over-fishing with lower catches. Aquaculture is more sustainable and therefore assures the community long-term prospects for gainful employment and income growth than is currently the case without the project. The benefits of the project extend beyond the community to other communities upstream.

9.1.7 Demographic Impacts

The demographic impacts of the project refer to changes to the population numbers and distribution. At full operation, Yalelo will employ over 250 persons on full time basis. Within a short period of 3 to 5 years, about 4-600 new residents are expected if workers’ spouses, children and other dependants are included. The influx due to project employment and attendant swift growth of the population could bring in businesses to Kamimbi. Skilled employees will come mainly from outside the immediate area. This is certainly a positive impact to the community and Siavonga District. Immigrants are often the most intelligent, hard-working and ambitious people of the communities they originate. They will bring their talents and skills to the project area. This is enriching to them and to the recipient community alike. They will add to the consumer base, thus helping the growth of the local economy.

The increasing attraction of Kamimbi as a business destination can also be at a cost. Rapid population growth can also be negative. Among the most negative effects of overpopulation is lack of land and resources which result in negative impact on the population. Waste management of such populations is also difficult to handle effectively and can result in pollution and detriment to the environment. Without adequate land per individual the quality of housing decreases. Another result is insufficient land to produce crops. This can lead to hunger and malnutrition. These can be catastrophic and cause repercussions in the process. As the population increases so is the need for improvement in social amenities. More investment in safe drinking water supplies and sanitation is required. Failure could bring about poor waste management, contaminated water supplies and high levels of disease, such as typhoid, dysentery and cholera.

9.1.7.1 Mitigation of Social Impacts of Demographic Change

Yalelo will endeavour to strengthen existing (traditional) institutions and through dialogue with local leadership assist in the development of new frameworks for addressing long-term development and

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18 Positive Effects of Immigration | eHow.com http://www.ehow.com/about_4781803positive-effects-immigration.html#ixzz1xYh9nceT
19 Effects of Rapid Population Growth | eHow.com http://www.ehow.com/about_5140073effects-rapid-population-growth.html#ixzz1xYjWXW2L
regional planning that addresses changes; for handling an increased number of disputes and social problems and gradually help to improve the capacity of the community institutions to accommodate a much more diversified population.

9.1.8 Health Impacts, HIV/AIDS and Malaria
An indirect impact of rising population due to immigration is the spread of HIV/AIDS. Kamimbi community is predominantly composed of fishers. Studies from around the world and in the in the past decade, indicate that AIDS-related illness and mortality are devastatingly higher in fishing communities.

Vulnerability to HIV and AIDS stems from complex, interdependent causes that may include the mobility of many fisher persons, the time fishers and fish traders spend away from home, their access to daily cash income in an overall context of poverty and vulnerability; their demographic profile (they are often young and sexually active) and the readily availability of commercial sex in fishing camps. In addition, cultural factors related to fishing as a high-risk, low-status and uncomfortable occupation, lead to high-risk sexual behaviour practices. Many of these cause make fisher persons not only vulnerable to HIV and AIDS but also more likely to miss out on access to prevention, treatment and care. Exposure to water-borne diseases and malaria, along with poor sanitation and limited access to medical care, also combine to increase susceptibility to infection. These proximate risk factors are all related to underlying poverty, insecurity and marginalization affecting both women and men in many fishing communities. The proportion of people infected with HIV in a fishing community, and the impacts of AIDS-related morbidity and mortality in that community, will depend on the extent to which the above factors occur and on how they combine to increase vulnerability.

The operation of the project will result in increased economic activity in the area consequently more people will be attracted to the area. This will expose the community to outsiders who may lead to the spread of HIV/AIDS and other STIs. Increased population could initially encourage more people to adopt fishing as an additional source of livelihood. Employment and new trading activities will equally support livelihood for the locals.

9.1.8.1 HIV/AIDS Mitigation
In order to reduce susceptibility to HIV/AIDS Yalelo will have to take the lead in adopting the ILO Code Practice on HIV/AIDS and the World of Work. Yalelo recognises the seriousness of HIV/AIDS epidemic and its impact on the workplace. The Company supports national efforts to reduce the spread and infection and minimise the impact of the disease. Accordingly, Yalelo will:

- Formulate and implement HIV/AIDS workplace and community policy;
- Sustain sensitisation of staff and community on the dangers of HIV/AIDS and STIs
- Support local programmes by Ministry of Health regarding HIV/AIDS such as through:
  - an awareness campaign programme for workers and community
  - Provision of free counselling and testing and preventive measures such as free condoms

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20 The State of World Fisheries and Aquaculture 2006: HIV and AIDS in fishing communities: a public health issue but also a fisheries development and management concern page 94
• Support development of a special comprehensive HIV prevention and care programme for fishing communities to address the unique characteristics of these communities.
• Establish a lakeshore hub of good practices for interventions among fishing communities.

Yalelo will also, whenever practicable, assist through planning, provision of adequate health services, drinking water and sanitary facilities to deal with the unexpected rise in the incidence of disease and pest problems and provide the necessary social, psychological and counselling services to old and new residents to enable them to cope with socioeconomic changes.

9.1.9 Gender Participation
Impacts from aquaculture might not be felt in the same way by both genders within the community, due to the physical nature of many roles within the company. As a result, and to minimize and mitigate this potential issue, Yalelo will employ women in as many roles as possible, e.g. net mending, cooking, cleaning and fish processing. It is envisioned that Yalelo will have a much higher proportion of female workers than the national average, thus helping to alleviate the issue at a national level.

Outside of the company, there is a risk that women may lose access to resources such as firewood. The loss of firewood due to Yalelo’s use of its plot is expected to be small. This risk is minimized and mitigated in the case of Yalelo due to:
1. Minimal fencing on the Yalelo plot
2. Free public access to the majority of Yalelo’s plot
3. No ban on taking firewood from Yalelo land
4. There is a vast amount of firewood in the large area of scrub bush within the Kamimbi area.

An increase in population due to the project can raise pressure on woodland resources on which women depend on for gathering of wild foods and firewood. Yalelo will assist in promotion of tree planting and control of bush fires to alleviate pressure on woodland for firewood and building poles. Bush fires suppress natural regeneration because they damage shoots and saplings. As a result, biomass is lost and re-growth is slowed, at the same time fuel wood and timber is extracted leading to a gradual erosion of vegetative material and forest health.

In the local community in general, men are often involved in fishing while women are engaged in fish processing and trading. However, because of low catches, the role of women in fishing is becoming marginalised. As a result, men are economically active but women are becoming largely involved in the reproductive sphere. Without Yalelo’s mitigation measures there is a risk that employment could favour men. Again, Yalelo will therefore take an affirmative employment policy to ensure balanced participation of women and men, alleviating the overall community and national issue.

9.1.9.1 Mitigation of Gender Inequalities
The project will contribute to gender equality and development as it will:
• Create opportunities for the empowerment of women such as targeting a higher percentage of female employees in all roles which are not physically demanding.
• Safeguard the rights and needs of vulnerable or marginalized populations, including women and youth through equal opportunity employment policies;
• Take into account the different vulnerabilities of men and women, due to differences in access to resources and different constraints in its employment policy.
• Target both men’s and women’s roles and tasks (such in fish production, harvesting and post harvest activities) so that both men and women are included.
• Identify any gender biases in institutions regarding who should be employed and ensure that both men and women are supported.

9.1.10 Impact on Public Infrastructure and Services
The project is located in a relatively neglected area. Public services are limited to only one school that can only accommodate a limited additional number of pupils from Grade 1 to 7. There is no health centre and the road is earthen and poorly maintained. Electricity supply is also substandard. The project will therefore require public investments in education, health, road and power supplies. Increased traffic will moderately increase pressure on the only road that leads to other population centres, Gwena, Munyama and Macamvwa and beyond. However, this road is not used heavily and Yalelo’s expects a limited amount of traffic to and from its site, e.g. 5-10 journeys per day.

9.1.10.1 Mitigation of Impacts on Public Infrastructure
Yalelo will promote an effective community and teacher parent involvement in the development of the community early child education and basic education services. This will take the form of supporting community self-help initiatives as led by the District Education Board.

Yalelo will also assist in local road improvement initiatives through its participation in the Siavonga Business Association, which acts in collaboration with the Siavonga District Council and local Chiefs.

9.1.11 Wider Socio-economic Impacts
In the case of socio-economic factors, the dominant impact of the project is positive due to the development it will bring, as detailed above. The primary direct benefit at the national level is improved Zambian food security and improved nutrition. In the medium term, the projected production will be 82% of current national aquaculture produce. If realised, the planned production will, within three years achieve 26% of required growth of farmed fish production projected by the national Aquaculture Development Plan 2010-2015, prepared by the Department of Fisheries. The planned Yalelo production is sufficient to meet the fish food requirements of 4,375,000 people for one week. This is a positive step forward for a population that is suffering declining fish consumption due to stagnant natural fish productivity and sluggish growth of aquaculture.

Yalelo will directly employ over 250 men and women upon full expansion and potentially up to 1,000 smallholder out-growers over time. This employment will provide an enormous boost to local livelihoods and the local economy. The project will stimulate economic activity within Siavonga District through its purchase of local goods. Direct fiscal contributions at the national level are in form of corporate income tax, VAT and personal income tax of employees.

Indirect fiscal benefits will be in form of downstream impacts on suppliers of aquaculture inputs; feed and seed. The project will create demand for inputs totalling several billion Kwacha per year in demand for feed alone. For this and other reasons, the project merits support as results in
sustainable positive economic development. This is within the context of a local population that has limited market opportunities and a nation that is chronically undersupplied with fish.

In summary, the project is expected to:

- Contribute to alleviating poverty for a significant portion of the rural poor population in an area that is socially marginalised and economically depressed.
- Create stable employment for over 250 individuals over time, and generate new income in aquaculture and fisheries.
- Enhance national food security in terms of self-reliance and self-sufficiency.
- Ensure rural equity, balanced regional development, gender equity through employment of young women and men and inter-generational equity.
- Be designed and implemented with prior consultation, consent and participation of affected populations.
- Introduce new and/or adapted technologies that are environmentally, economically and socially sustainable.
- Introduce preventive measures that reduce degradation of natural resources by encouraging aquaculture rather than destructive capture fishing practices. This will also protect natural ecosystems and biodiversity, and reduce human risk.
- Increase local and national understanding and knowledge of sustainable development processes by directly promoting aquaculture.
- Develop and demonstrate a new model of sustainable investment management.
- Improve local management and technical capabilities through transfer of technology to local employees.
- Provide for training, extension and economic incentives to local community through the out-grower services.
- Include participation of people affected by cage culture in decision-making process and therefore better control of their own future.
- Diversify and expand productive activities, supply of inputs, markets and self-sufficiency to an area currently dependent on outside resources.
- Benefit or involve indigenous peoples (ILO convention No. 169) and FAO policy on indigenous people through Yalelo affirmative employment policy by giving priority to local and historically disadvantaged population groups.

The project has additional positive impacts on realisation of the National Aquaculture Development Strategy. The project is recognition of the core principles of the National Aquaculture Development Strategy as demonstrated that aquaculture can be undertaken profitably; improves access to high quality production sites such as Kamimbi on Lake Kariba; demonstrates fish health management through implementation of best cage aquaculture practices and enhances marketing of fish.

9.2. Project Impacts on Environmental Resources

The project will follow the ecosystem approach to fisheries and aquaculture and therefore adhere to the United Nations Food and Agricultural Organisation (FAO) Code of Conduct for Responsible Fisheries and Aquaculture. The project will therefore:
• Preserve aquatic ecosystems and protect the quantity and quality of fisheries resources, including genetic resources.
• Avoid dumping of fish processing wastes in water bodies.
• Avoid the depletion of other fishery stocks or wild populations.
• Protect artisanal fisheries and commercial fishing vessels and their gears from conflict with cage culture facilities.
• Protect small-scale farmers and local communities.

9.2.1 Impact on Land Resources

Improper location of farm activities can harm the environment. In order to conserve the natural habitat and local biodiversity the farm layout is such that it does not disrupt the structure of native fish population, enhance eutrophication in the receiving waters, and cause the loss of sensitive habitat. The farm layout takes into account other Lakeshore activities and avoids negative impacts on the lake and land resources. The farm layout is available in previous sections. This is in line with the guiding principles of Zambia’s land policy which inter alia state:

1. The principle of land as a common heritage, a national and communal resource and asset for meeting long term needs of the people of Zambia;
2. The principle of citizenship as right to land individually, severally and or collectively anywhere in Zambia;
3. The principle of optimal land use among uses and users such as human settlement uses, industry and commerce, infrastructure, agriculture, forestry and mining, the protection of right to access and wise use of water bodies in the long-term interest of the people of Zambia.
4. The principle of encouraging fair and equitable access to land and secure tenure among all the people of Zambia irrespective of their abilities, race, beliefs, gender and ethnicity.
5. The principle of user liability for restoration of environmental changes of land values;

Accordingly, and as detailed previously, Yalelo respects the 100 metre public reserve land from the high water mark and location of farm services 20 metres from the 100 metre mark. Furthermore, Yalelo is committed to maintenance of its community agreement that “all stakeholders involved should respect every user’s rights and avoid interferences”. Therefore, “fencing should not be pursued wantonly and for its own sake as the area is also being used by game animals and humans for their own needs”, except “…for areas security and safety of persons and property”\textsuperscript{21}.

9.2.1.1 Mitigation of impacts on Land

Site selection

A full evaluation in consultation with the Department of Fisheries and the community to ensure that ecological and social conditions are sustained and protected shall be carried out at each stage of the development. The following mitigation guidelines will apply:

• Topography, soils and ecosystem for construction of ponds will be taken into account;

\textsuperscript{21} Excerpts from the resolutions of the Stakeholder Meeting of 11\textsuperscript{th} May, 2012
• Alternatives to mitigate potential environmental and social impacts shall be considered;
• Yalelo will seek appropriate permissions from the regional and local land use planning authority.
• Actively involve the participation of local people in implementation of activities that affect them.

Farm design and construction
Proven acceptable designs and construction procedures shall be adopted to overcome problems related to floods, storms, erosion, and seepage, water intake and discharges;
• Embankments shall be designed to prevent erosion and usage of HDPE pond liner will reduce seepage;
• The farm shall be designed to allow for all facilities to provide most efficient water management and manipulation of stocks;
• A waste water treatment/settling pond area for water treatment before effluent is returned to the lake will be used. The pump station will be situated on the off-shore to pump clean water into the operations;
• A buffer of 20 metres from 100 metre reserve from the high water mark to serve as a buffer against flooding.
• Appropriate authorisations and water rights have been sought for abstractions of lake water from the Water Board;
• Fish cages, floating or stationary shall be installed at least 6 metres from the bottom, at least 10 metres apart and at least 50 metres between cage clusters to provide water exchange.

9.2.2 Impact on Water Quality
Effluent water from the breeding ponds will be treated through a constructed wetland and sedimentation/settling pond before it is discharged into the Lake. Similarly, water from the processing plant will also be discharged through an anaerobic (septic tank) sewerage system. To avoid the excessive loading of nutrient-poor systems, a limit on the total phosphorus concentration in these receiving waters has been imposed. Additionally, a limit on the concentration of chlorophyll a has been established in an attempt to restrain the primary productivity in these water bodies.

Secchi disk visibility measures the amount of turbidity in a water column. When this method is used on systems that are not turbid via suspended sediment (note: the distinction should be made during audits between turbidity from plankton versus turbidity from suspended sediments), a strong correlation exists between low primary productivity and high Secchi disk visibility. Thus, Secchi disk visibility is a useful tool to understand key characteristics of the water. In the context of the Best Aquaculture Management (BAM), oligotrophic receiving waters have a Secchi disk visibility equal to or greater than 5.0 meters.

To reduce effects of nutrient loading, the developer shall take all the necessary measures required to maintain good water quality. Such measures are necessary to avoid eutrophication of the Lake – even though it is unlikely for relatively small amount of nutrients as those involved to change the water quality of such an immense reservoir. However, in order not to risk localised and temporal maintain through:

• A relatively lower stocking rate;
• Investments in effluent treatments;
• Quality feeds and good feeding practices and
• Periodic fallowing of cage sites.

These and other measures designed to maintain the water quality in its current state are discussed below. Thus, in order to maintain good water environment and the oligotrophic state of the Lake the project will not discharge wastes directly. Pond water quality shall be influenced by minimising water exchange and through moderate stocking densities and good feeding practices using high quality feeds and good feeding practices.

9.2.2.1 Mitigating Water Quality Impacts – Water Discharge/Sludge/Effluent Management

There shall be proper waste management to enhance protection of Lake water resources through:

• Effluent, sediments and other wastes shall be disposed of through the use wastewater treatment and settling ponds;

• Sediment from ponds, canals or settling basin shall be put back into the areas from which it is eroded off or in other environmentally responsibly. We are developing a garden and all dredges will be used as fertilizer. This could prove useful to the surrounding farmers as well for they can use the same as fertilizer

• Discharged water will stay for 76 hours in the sedimentation/settling ponds thereby ensuring effluent meets water quality and quantity standards – avoiding release of turbid and odorous water – while quantitative standards shall include the maximum and / or minimum levels of suspended solids, measure of acidity (pH), dissolved oxygen, ammonia and other nitrogenous compounds, phosphorous, carbon dioxide and biochemical oxygen demand (BOD).

Effluent water released from ponds will collect into a common drainage furrow through wetlands into the settling ponds where it will be retained for three days. The effluent ponds will be stocked with locally available *lemna* duckweed which will assist in extracting phosphorus and nitrogen from the effluent, which are the major elements implicated in eutrophication of water bodies. The *lemna* duckweed will be regularly harvested and then incorporated into fish feed to ensure the ongoing uptake of nitrogen and phosphorus from the effluent.

The settling ponds will be stocked with local fish species which will subsist on plankton food created as a result of residue nutrients in the ponds. Aeration will be carried out to aid decomposition. As much as possible of the effluent will then be used in the Yalelo facilities for gardens and organic vegetable plots.

**Pond dimensions from which effluent is discharged:**

- Breeding ponds - 25 ponds (20mx10mx0.8m). Exchange rate 10%
- Holding ponds – 12 ponds (30mx30mx1m). Exchange rate 2%
- Grow out ponds – 16 ponds (30mx25mx1m). Exchange rate 10%
- Two settling ponds with a total of 6720m$^3$
- Volume of effluent 1,816m$^3$/day (based on the sizes and exchange rate above)
It can therefore be seen that the volume of the effluent ponds is sufficient to comfortably hold all pond off-take for three days, as $1816 \text{m}^3 \times 3$ is within the available settling pond volume of $6720 \text{m}^3$.

The exact location of the settling ponds can be seen on the Site Layout Diagram at the beginning of Section 6 of this document. They are to the west of the main yard and south of the hatchery.

**Effluent from the processing factory** will be managed through the following practices, in line with international best standards:

1. Mechanical filters which are self cleaning will be provided in the flow through system to eliminate any suspended solids.
2. Biological filters will also be fitted to remove accumulated harmful substances such as nitrogenous wastes from the effluent. These filters will eventually reduce on the Biological oxygen demand of the waste water that enters the settling ponds.
3. The wastes from the factory will pass through a coagulation pond to provide for the extraction of oils and fats before entering the settling ponds.
4. About 400m$^3$ of water entering the factory per day will undergo purification process.
5. The final discharge point will have BOD measuring to the acceptable levels (4mg/L)

Note, fish wastes such as blood, bones and guts are to be further processed and sold to animal feed manufacturers and fertilizer manufacturers; therefore effluent consists only of water runoff used when washing fish.

9.2.2.2 Mitigating Water Quality Impacts – Use of Drugs, Chemicals and Fertilisers

The use of toxic pesticides, drugs, chemicals and fertilisers shall be practiced to foster proper use of therapeutic agents and other chemicals without endangering food safety and the environment. There shall be proper use of chemical substances. Accordingly:

- Yalelo undertakes to use only approved drugs upon a prescription of such from its own/practising competent veterinary. If and when chemicals are used, pond water shall not be discharged until the chemicals are degraded/dissipated or naturally decomposed to non-toxic state.
- Records of use of chemicals shall be maintained as suggested by Hazard Analysis and Critical Control Points (HACCP) method.
- Banned Chemicals shall not be used.
- The use of drugs, antibiotics and other chemical treatments shall be in accordance with recommended practices and comply with national and international regulations.
- The developer shall follow the information on product labels regarding dosage, withdrawal period, proper use, storage, disposal and other uses to safeguard the environment and human safety.

9.2.2.3 Mitigating Water Quality Impacts – Stock Selection and Stocking Practices

Stock selection and stocking practices shall ensure increased production of good quality and disease free stocks to promote profitable farming. Therefore, the developer shall ensure that:
• Moderate and appropriate stocking density shall be employed. For production cages, a final stocking density of 35k/m$^3$ will be used while 10kg/m$^3$ will be employed for juvenile fish
• Only species already present in the Lake shall be cultured;
• Only healthy fry and fingerlings shall be stocked. We will employ grading throughout our production process
• A qualified professional will be engaged to ensure that health audits are done to ensure thorough screening of disease and consistence through developing of protocols on good stocking practices.
• Hatchery fry and fingerlings shall be used and not wild caught. Fry will only be procured from a trusted source (in the absence of own hatchery) and in accordance with best practice, under the management of a qualified Hatchery Manager.
• The introduction of exotics or and Genetically Modified Organisms shall not be cultured or introduced in the Lake by the developer.
• Yalelo undertakes to use two strong nets per cage to avoid fish escapes. Divers will be employed to frequently check the integrity of the nets. Appropriate mesh size nets will be used depending on the size of fish under movement. This will curb escaping of fingerling into the wild thereby competing with the wild populace for resources.

9.2.2.4 Mitigating Water Quality Impacts – Feed Use and Feed Management

The following practices shall be adopted to maintain water quality, improve efficiency of feeds and feed management and at the same time reduce the amount of wastes discharged into the environment.

• Feeds shall be selected for their high utilisation rates to reduce the nutrient pollution from uneaten feed and excreta.
• Yalelo will employ a qualified expert to deal with issues of feed formulation that will ensure feed efficiency, low feed conversion ratios, maximum feed floatability
• Feed shall include balanced levels of amino-acids and other nutrients appropriate for age of the fish, high palatability to stimulate consumption and high stability to prevent rapid nutrient release.
• Ideally only extruded feeds shall be used.
• Feed shall be stored in cool and dry areas to prevent contamination.
• Medicated feeds shall be used only if and when necessary for the control of specific diseases;
• Feeding management shall be in conformity with carrying capacity, stocking density and size of the fish.
• Good feeding practices shall be employed to ensure minimal feed wastage and this will be achieved by the use of appropriate technology like feed blowers and automatic feeding mechanism.
9.2.2.5 Mitigating Water Quality Impacts – Fish Health Management

The following disease prevention practices shall be complied with to provide effective management of fish health by focusing on prevention rather than disease treatment, eventually reducing disease incidence and protecting natural fisheries.

- Promotion of sustainable and good aquaculture management practices.
- Appropriate quarantine procedures, handling, transport and proper acclimatisation of healthy fry and fingerlings prior to stocking shall be strictly observed.
- Good water quality shall be maintained using appropriate stocking and feeding practices.
- For non-infectious diseases, specific corrective management measures shall be carried out.
- For mild infectious diseases, with potential to spread within the farm, the pond or cage shall be quarantined and remedial measures shall be applied.
- For serious infectious diseases that may spread widely, the pond shall be isolated and the remaining fish harvested by net and disinfected without discharging the water.
- Treatment shall be done when necessary.
- The developer will participate in the national programme on fish disease information, surveillance and reporting system.
- On site monitoring and reporting shall be conducted by a competent aquatic animal health officer.

9.2.2.6 Mitigating Water Quality Impacts – Database Management and Reporting

Data management shall be properly coordinated with all agencies and producer networks. This shall be through:

- Database of environment, social and land use impacts and operational statistics.
- Linkages with local and national information networks shall be pursued.
- Submission of annual reports as requirement for renewal of licenses and other regulatory requirements;
- Regular monitoring and post EIA audits.

9.3 Impacts on Biodiversity

Most farmed species are genetically different from native species and there is always concern about genetic contamination from the release of farmed species into the wild. Domestic fish are bred for traits that may not be optimal for survival in the wild. If some escape into the wild, for example, if a storm or predator attack damages a pen, the viability of wild populations may be threatened by inter-breeding.

Aquaculture can affect local biodiversity in other ways. The movement of broodstock and fry within a country or between countries may significantly alter the genetic characteristics of local stocks of
the same species through escapes. Organic loading from cage aquaculture can also cause a decrease in benthos flora and fauna biodiversity.

9.3.1 Mitigation of Escaped Fish on Wild Fish Population
In order to avoid escape of farmed fish into the wild, ponds will have series of net meshes and/or grill and screens and barriers on inlets and outlets of culture facility. Cages will be double netted with strong and appropriate nets, including a predator net. Nets will be appropriately sized to retain the stocked fish.

Ponds will have trapping devices placed in effluent/drainage canals or in between cages to sample for escapees and a record of findings and actions taken. In cage culture systems, the minimum distance between the bottom of the cage and the bottom of the receiving waters where the cage is placed will be 6.0 m.

9.3.2 Mitigation of Organic Loading on Biodiversity of Benthic Flora and Fauna
Very little is known about the biodiversity of benthic microbial, plant and animal groups of Lake Kariba. However, the rate of loss of biodiversity can vary according to seasonal factors and intensities of disturbances to the habitats as well as the number of species inhabiting particular areas.

In order to avoid build-up of organic nutrients below the cages and associated impacts on benthic flora and fauna, the recorded data or the management plan will be used, based on the information recorded, to fallow cages. Ideally, cages should be moved every five years.

9.4 Significance of Impacts Combining
According to the determination of the combination of impacts, including chemicals, could have an impact on the environment if not properly monitored, minimized and mitigated. Accordingly, the Government of Zambia discourages the use of chemicals and veterinary drugs for curative purposes preferring prevention than treatment. Where treatment is required, Yalelo undertakes to be guided by competent and practising experts in this field for controlled use of recommended drugs/substances. However, Yalelo’s motto is to prevent rather than cure and this will be possible through the use of best aquaculture practise guidelines.

<table>
<thead>
<tr>
<th>Impact</th>
<th>Frequency</th>
<th>Duration</th>
<th>Severity</th>
<th>Extent</th>
<th>Sensitivity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soluble wastes</td>
<td>High</td>
<td>Short</td>
<td>Low</td>
<td>Local</td>
<td>Low</td>
</tr>
<tr>
<td>Solid wastes</td>
<td>High</td>
<td>Continuous</td>
<td>Low</td>
<td>Local</td>
<td>Low</td>
</tr>
<tr>
<td>Chemical wastes</td>
<td>Low</td>
<td>Short</td>
<td>Low</td>
<td>Local</td>
<td>High</td>
</tr>
<tr>
<td>Physical structures</td>
<td>High</td>
<td>Long</td>
<td>Low</td>
<td>Local</td>
<td>Low</td>
</tr>
<tr>
<td>Oxygen depletion</td>
<td>Low</td>
<td>Short</td>
<td>High</td>
<td>Local</td>
<td>High</td>
</tr>
<tr>
<td>Turbidity</td>
<td>Low</td>
<td>Short</td>
<td>Low</td>
<td>Local</td>
<td>High</td>
</tr>
<tr>
<td>Disease transmission</td>
<td>Low</td>
<td>Short</td>
<td>Medium</td>
<td>Wide</td>
<td>High</td>
</tr>
<tr>
<td>Genetic mixing</td>
<td>Low</td>
<td>Long</td>
<td>Medium</td>
<td>Wide</td>
<td>Low</td>
</tr>
<tr>
<td>Biodiversity</td>
<td>Low</td>
<td>Long</td>
<td>Low</td>
<td>Local</td>
<td>Low</td>
</tr>
</tbody>
</table>
Long term impacts with long term and wider environmental implications are of biodiversity and genetic mixing effects. However, the stocking of all male fish rather females, reduces the severity of these impacts.

9.4 Impact of the Environment on Aquaculture

Cages are subcomponents of the aquatic ecosystems where they are situated; since the enclosure and the surrounding environment are intimately related i.e. changes occurring in the water body will have an effect on the enclosure environment and vice versa. This section examines the impacts of environmental elements on the ‘enclosure’ environment.

9.4.1 Predation

Cages attract a wide range of both obligate and facultative fish-eating vertebrates. The range of species reported to cause problems at cage farms includes fish, reptiles, birds and mammals. Many of these species move into an area where a fish farm has been established, attracted by the large numbers of readily detected fish and also by the bags of commercial feed if left unprotected on the cage walkways.

Damage to nets by unsuccessful predators such as birds, tortoises, monitor lizards and rats has been reported, thus contributing to the loss of fish and feed from fish farms. Tiger fish, *Hydrocynus vittatus*, has historically been the more menacing predator to fish in floating cages on Lake Kariba22. Predation of wild fish close to the enclosure site may increase through the attraction of predators and other fish alike.

Another potential, although as yet little studied, impact of the immigrant predator population, is their contribution to disease. Certainly both birds and mammals play important roles in the life cycles of many commercially important endoparasitic fish diseases. For example, birds act as intermediate host in the life cycle of the nematode *Contracaecum*, and piscivorous mammals such as the otter may act as final host for the digenean *Haplorchis*, both common parasites of tilapia.

9.4.1.1 Mitigation to Predation by Fish Eating Vertebrates

As already indicated in the discussion on mitigation of escapees, double netting with anti-predator nets reduces the impact of predators on fish pens. Equally useful is covering of the cage top to avert bird attacks. In case of ponds, lines will be used to cover the ponds and hapas will be covered by bird nets.

9.4.2 Impact of Rough Weather Episodes

In Siavonga, gusty weather is often a cause of considerable damage to fish cages. In 2010, Salim Dawoogi of Savannah Streams in Gwena Bay lost 90,000 fish to rough wave action. Tune Enterprises had to relocate their cages from end of Kanyelele Cove upstream to Macamvwa Bay due to repeated losses they face to gusty Sanyati currents23. These losses however benefit capture fishery catches tremendously in the weeks following the disaster.

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22 Pers. com. Stanley Hamweene, Foreman on Transcontinental cage aquaculture farm 28.11.2010
23 Pers. com. Kate McIntosh 30.11.2010
### 9.4.2.1 Mitigation of the Impact of Storms on Cages

In addition to suitable site selection, Yalelo uses floating cages that are designed to withstand sea conditions rather than traditional cages made of local materials. This will significantly decrease the risk of loss of fish due to adverse weather.

#### Table 12: Checklist of Impacts and Mitigation Strategies for Land based (Hatchery) Aquaculture during Construction

<table>
<thead>
<tr>
<th>Action affecting the Environment</th>
<th>Potential Impacts</th>
<th>Mitigation Strategy</th>
<th>Time Frame</th>
</tr>
</thead>
<tbody>
<tr>
<td>Site selection</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Conflict with other land users and interference with livelihoods of local communities</td>
<td>On and off site damage to resources and social conflicts</td>
<td>Appropriate land use planning Consultation process Participation of local people Resettlement and compensation</td>
<td>During and after project implementation</td>
</tr>
<tr>
<td>Water quality</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Water quality</td>
<td></td>
<td>Management practices and effluent controls</td>
<td>Throughout project life</td>
</tr>
<tr>
<td>Disease problems</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Disease problems</td>
<td>Presence of serious pathogens</td>
<td>Survey of existing farms prior to investment and introduction of risk management strategies</td>
<td>Before and during</td>
</tr>
<tr>
<td>Farm design</td>
<td>Poor design leads to a variety of environmental problems</td>
<td>Careful and appropriate design</td>
<td>Before project</td>
</tr>
<tr>
<td>Farm Construction</td>
<td>Damage to terrestrial and wetland habitats and water quality problems during construction.</td>
<td>Maintain buffer zones, ensure limited site disturbance, regulatory guidelines should be followed during construction</td>
<td>Before during and after project</td>
</tr>
<tr>
<td>Dyke compaction</td>
<td>Seepage due to poor compaction</td>
<td>Dyke compaction tests during construction</td>
<td>Prior and during</td>
</tr>
<tr>
<td>Waste water/ effluent discharge</td>
<td>Impacts on surrounding land use and wetland habitats</td>
<td>Non-organic solids should be dumped in a responsible manner</td>
<td>Throughout project</td>
</tr>
<tr>
<td>Water intake and conveyance</td>
<td>Water pollution problems impacting on water quality</td>
<td>Consider provision of a settlement basin/pond</td>
<td>During project implementation</td>
</tr>
<tr>
<td>Harvesting and pond bottom management</td>
<td>Sedimentation leading to water pollution</td>
<td>Settlement pond to catch and trap sediment</td>
<td>During project implementation</td>
</tr>
</tbody>
</table>
10.0 Environmental Management Plan

The aim of an Environmental Management Plan (EMP) is to avoid the possible adverse impacts of a project and to maintain the existing environmental quality. The EMP communicates all aspects of planning, construction and operation of the project, which are relevant to environment. It is essential to implement the EMP from the planning stage and then continuing it throughout the construction and operation stage. Therefore the main objective of the EMP is to identify the project specific activities that should be considered as having significant adverse impacts and the mitigation measures required.

The environmental management plan involves documentation of land use and water quality issues during construction and operations. The project involves pond fish breeding and on-growing in offshore cages. An Environmental Management Plan (EMP) can be defined as “an environmental management tool used to ensure that undue or reasonably avoidable adverse impacts of the construction, operation and decommissioning of a project are prevented; and that the positive benefits of the projects are enhanced”.

An EMP is therefore important tools for ensuring that the management actions arising from Environmental Impact Assessment (EIA) processes are clearly defined and implemented through all phases of the project life-cycle. It is proposed to set the environment management plan for the Cage Culture Project alongside the Best Management Practice Guide which spells out recommended good practice at all stages of the aquaculture project cycle to mitigate adverse environmental impacts of cage aquaculture on the environment and vice versa.

The objectives of the EMP should be understood in terms of the following approaches (strategies) to environmental management:

- Good Aquaculture Management Practices
- Site Selection and Management
- Environmental Protection
- Nature and Biodiversity
- Waste Management and Reduction
- Water Quality Management and Conservation

10.1 Good Aquaculture Management Practices

Good cage aquaculture practice avoids placement of cages in shallow water as they tend to act as a floating barrier causing differences in speed, direction and eddy (current). The most discussed issue of cage aquaculture impact on the environment is the effect on water quality. However, this is probably ineffective without a prior baseline assessment. In addition, the EMP should be regularly reviewed and management objectives should be examined and continuously improved. For an EMP to work properly, good record management is compulsory.

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Similarly effective EMP begins with appropriate site selection is one of the key issues for success in aquaculture. Poor site selection makes aquaculture difficult to manage and may also lead to the destruction of critical natural habitats, spread of diseases and contamination of freshwater sources. When selecting sites for aquaculture infrastructure the following points should be considered:

i. Documentation of all the regulatory requirements for the site and consider alternatives for compliance with the regulations.

ii. Survey local communities to determine demography, resource use patterns, availability of labour and compatibility with project goals.

iii. Survey existing fauna and flora, with particular attention to effects of the project on animal migration routes and nesting grounds or protected areas.

iv. Maintenance of adequate distance between farms or aggregate of ponds, natural spawning runs, restricted areas (conservation areas) and sensitive ecosystems (including lakes, rivers).

v. Choose areas with adequate currents to minimise waste accumulation below the cages. Currents help disperse waste and replenish the water with oxygen.

vi. Avoid use of sites with incompatible users. Do not use polluted sites with chemicals, pesticides or other pollutants.

Similarly, when siting ponds, attention should be given to suitability of topography, soil and ecosystem for pond construction. Ponds should be located in sites where they will not cause destruction of habitats such as wetlands, rivers, inlets, bays, estuaries, swamps, marshes or high wildlife-use areas. The site should have good soil, preferably clay-loam or sandy clay, that will retain water and be suitable for building dikes. Alkaline soils (with pH of 7 and above) are preferable to avoid problems resulting from acid-sulphate soils such as poor fertiliser response, low natural food production and slow growth of cultured species and probable fish kills. Acid and organic soils (high in humus or compost) are also not suitable. In addition, the following measures should be considered.

i. Provide a buffer zone for areas near river banks that are exposed to wave action.

ii. Ensure that the area has a regular supply of water, in adequate quantities throughout the year.

iii. Water supply should be free of pollution and with adequate pH.

10.2 Site Selection and Management
Site management begins with high quality construction, regular maintenance, detailed site plans, equipment inventories and absence of unsightly junk yards. Facilities should blend with surrounding area to ensure low visibility and scenic beauty.

Cage structures on water for instance may not be a pleasant feature and can mar the water surface and could be unacceptable in eco-tourism areas. This however is temporal and not a permanent loss since these structures can be moved and set up elsewhere. The importance of careful site selection cannot be clearer.

Good construction of ponds is the best way to incorporate good site selection and mitigation measures in farm design to avoid problems related to flood levels, storms, erosion, seepage, water intake and discharge points. Planning of clearing and earth movement during construction can prevent ecological damage during construction and assist proper management during operations. It is therefore recommended to:
i. Use design features and good construction methods to overcome site limitations and mitigate potential negative environmental problems.

ii. Adopt successfully tested and proven designs and construction procedures.

iii. Design ponds in such a way that prevents storm and flood damage that could cause overflow discharges.

iv. Settling ponds for the effluents should be provided and, if necessary, for water intake, if the water supply has high sediment loads.

v. The pond depth should be shallow enough to prevent stratification (potentially dangerous laying of pond water into a warmer upper layer and a cooler, dense, oxygen-poor lower layer).

vi. Isolate supply and effluent canals as far as possible from each other, and from other farms.

vii. Line bottoms and sides of ponds, levees and canals with impervious matter in order to prevent seepage into surrounding soils and groundwater.

viii. Construct storm water bypass around the area of the ponds.

ix. Dig ponds deep enough to prevent weed growth. Minimise sediment erosion by:
   a. Incorporate topography, soil quality and water source in construction;
   b. planting vegetation;
   c. compacting and lining the banks;
   d. making discharge channels large enough to handle peak loads without scouring;
   e. construct wetlands to treat the settling ponds water from fresh water ponds;

10.3 Environmental Protection

Environmental protection is achieved by sound farm management. In this regard, this involves good pond and cage aquaculture management. Good farm management should aim at operating towards achieving environmental sustainability and profitability at the same time.

Ponds should be managed in such a way that they do not cause loss or significant damage to habitats, including rivers, inlets, bays, estuaries, swamps, marshes, and other wetlands. Pond entrances and exits should be fitted with screens to keep fish stock in and other animals out.

In order to maintain water quality, aeration, sustainable stocking rates, controlled feeding rates, and adequate water exchange should be maintained all the time. In addition, effluents should be treated in settling ponds. Waste waters should always be treated before discharge. In addition,

i. Effluents can be used as liquid fertiliser on crops or grass lawns as needed.

ii. Monitor and control effluents before discharging to meet water quality standards for turbidity, suspended solids, BOD, pH, dissolved oxygen (DO), ammonia, nitrate, nitrite, disease organisms and phosphorus.

iii. Alternate freshwater ponds, where possible, and allow ponds to dry out, lie fallow, or grow a crop to reduce the need for sludge and nutrient removal.

Good farm management requires that cages should be located where there is adequate wind action. Wind will help flushing and contribute to increased dissolved oxygen concentration in water. Deepwater sites with no current reversals are especially suitable and areas with aquatic vegetation should be avoided. Therefore cages should not be placed in stagnant deep water because of the potential deep-water deoxygenation. They should instead be placed in areas with current action. Currents
help water flows through the cages removing metabolites and replenishing oxygen. For this reason, cages should be oriented according to prevailing winds and currents, to minimise shading and prevent debris from collecting between them. In addition:

i. Locate cages where disturbance from people and animals can be minimal.
ii. Use strong nets to construct cages.
iii. Construct all cages to prevent break up of facilities and loss of stock, wastes, feed or supplies even in severe weather conditions.
iv. Move the cages as and when the conditions are leading and this will be a function of the monitoring system adopted on the management plan.
v. Place a bag or other container around all net pens to isolate diseased fish. The bag should be impermeable and capture all fish wastes.
vi. Arrange to treat and neutralise bag water or wastewater before discharge. Collect and dispose of waste feed and faeces from bagged or contained pens as compost.
vii. Avoid discharges near or up current from fishing grounds or other sensitive areas.

Cages should not interfere with other water uses and markers are useful aids to define the cage facility perimeter. The use of therapeutic agents must always be treated as a last alternative and if absolutely necessary, the instructions on the product label should be followed carefully as chemicals may affect non-target species and may have residual effect on animals and humans.

General prevention of spills taints and odours should be controlled and contingency and mitigation plans for leaks and spills should be part and parcel of overall farm management. General preventive measures for protection of the environment should include the following strategies:

- Protection from oil contamination
- Emergency Spill Response Plan
- Visual impact reduction
- Noise impact reduction
- Odour impact reduction
- Feed management & nutrient impact reduction

Eutrophication arising from increased nutrients loadings (faecal and uneaten feed wastes) that dissolve or settle on the bottom beneath the cages. This can lead to eutrophication of the water surrounding cages. Fish excretion and faecal wastes combine with nutrients released from the breakdown of excess feed thereby raising nutrient levels well above normal, creating an ideal environment for algal blooms to form. Once the resulting algal blooms die, they settle at the bottom where their decomposition depletes the oxygen. Algal toxins may also be produced before bloom dies.

Poor feed quality is another source of eutrophication. Fish cannot digest starch effectively resulting in excessive excrement which causes physiological problems such as excessive gas, bloating diarrhoea apart; from affecting the growth of the fish also lead to water pollution. Pellets of floating feeds aid digestion. The extrusion which is a high temperature and short duration process cooks the feed ingredients killing the germs and pathogens and makes the feed easily digestible. Thus the use of good quality feeds has the advantage of easy digestion, faster growth, water quality protection, zero water pollution, optimized labour usage and zero wastage of raw materials. The use of sinking
feeds leads to settling of feeds on pond or cage bottom causing pollution. Besides, there is also a lot of wastage in the process. Extruded feed is safer, because fed ingredients are pasteurized or sterilized during feed extrusion operation, thus reducing the effects of feed on the health of aquatic animals and water quality.

Good quality feed should float long enough to reduce waste as the feed is usually broadcast on the surface of the water and is consumed by the fish as it settles through the water column. If more feed is uneaten, a great deal of it will settle on the bottom where it is eaten by benthos or decomposed by micro organisms. This alteration of the natural food web structure can significantly impact the local environment. Overfeeding in fish farms may cause changes in benthic communities’ structure because of high food supply. Moreover, other animals may die if the water is depleted of oxygen as a result of microbial decomposition.

Although some species of phytoplankton can benefit from an increased supply of nutrients, certain species are toxic to other organisms and to humans. The spines of some diatoms (e.g. Chaetoceros concaviconis) can irritate the gills of fish causing decreased production. Certain bloom species such as Chattonella marina often produce biological toxins that can kill other organisms. Toxins produced by algal species create a serious health risk to people consuming contaminated fish. Some fish pathogens such as Streptococcus bacteria can infect humans.

Bio-fouling is occurs when the water exchange in a cage is restricted due to a build up of algal and other organisms. Certain bryozoans species can attach to the edge of cage nets and severely block the flow of water. Filaments algae can also accumulate on cages and restrict water exchange.

### 10.4 Nature and Biodiversity Conservation

Farmed fish escapes can have impacts on wild stocks through competition, interbreeding as well as spreading parasites and causing genetic pollution via interbreeding and hybridization. Escapees have the capacity to spread infectious diseases to wild populations. The potential for deliberate release of genetically modified fish or (transgenis) fish without containment measures raise public concern in term of risk to the environment.

Competition of wild fish with escapees can also alter or modify the pre-existing natural and fragile aquatic habitats and destroying some segments of aquatic environment. That is why it is necessary to install nets that extend above the water line to prevent overtopping by storm surges or waves. The use of anti-bird predator net also helps reduce bird attacks and thefts which may increase the number of escapees. That is why cages should be made of sturdy, non-corrosive material to minimise escapees. Furthermore, thorough inspection of nets before they are deployed is important to avoid possible escapes from the cages. Equally important is for workers to be well trained and conversant with protocols for transferring; changing nets or harvesting fish from the cages e.g. use of fish boxes. Divers or underwater cameras if available must be used to periodically inspect cages for holes, rips or tears.

### 10.5 Waste Management Plan

The management objective of waste management plan is water quality conservation because water is the main environmental resource requiring conservation. Without conservation of water quality, the project sustainability becomes impossible because aquaculture and above all cage aquaculture...
needs healthy water quality to be economically and financially viable and profitable. Towards this goal, Yalelo will pursue a three pronged strategy: waste minimisation, maximising waste recycling and reuse and promoting environmentally sound waste disposal and treatment. In this regard, the waste management plan is based on the principles of prevention, reduction, reuse, recycling & recovery. This is the guidance to all waste treatment strategies already discussed in the relevant sections above for pond effluent water and discharges from the fish processing plant.

It is therefore suggested that cleaning of fouled nets will not be conducted on site. Nets will be brought to shore for cleaning at an approved land based facility. Nets will be replaced at least at the beginning of each production cycle, and replaced more often as required.

10.5.1 Pond effluent treatment
Solid waste from aquaculture ponds consists of decomposed fish, faecal matter, uneaten feed and other pond debris, and is rich in nitrites and ammonia. This organic material can be used for agricultural crops, in compost facilities or as a topsoil additive. If these options are not available, waste may be sent to a landfill or waste treatment facility for disposal.

10.5.2 Processing plant wastes
Mechanical filters which are self cleaning will be provided in the flow through system to eliminate any suspended solids. Biological filters will also be fitted to remove accumulated harmful substances such as nitrogenous wastes from the effluent. These filters will eventually reduce the Biological oxygen demand of the waste water that enters the settling ponds.

Processing plant wastes will pass through a coagulation pond to provide for the extraction of oils and fats before entering the settling ponds. About 400m$^3$ of water entering the factory per day will undergo purification process. The final discharge point will have BOD measuring to the acceptable levels (4mg/L).

10.5.3 Cage culture wastes
The project will develop and comply with site-specific waste management plans as required by the BMP. The aim of the waste management plan is to ensure proper disposal of all waste materials generated at the facility. Categories of waste covered include, but are not limited to: operational debris, hazardous waste, human waste, bio-fouling, fish mortalities, fish feed, waste products from harvesting.

Yaleo will have a contingency plan for unexpected high mortalities. In that case the dead fish will be processed into animal feeds. At all times, records of disposal shall be maintained and updated as required.

10.6 Water Quality Monitoring
Resource monitoring will be achieved through water quality monitoring. Table 13 presents the variables Best Aquaculture Management Practice Guide for land based farms. Accordingly, the variable units of measurements are given – an initial value is proposed and final upper limit value given.
Table 13: Effluent Management BAP Water Quality Criteria for land-based fish farms

<table>
<thead>
<tr>
<th>Variable (Units)</th>
<th>Initial Value</th>
<th>Final Value (after 5 years)</th>
<th>Collection Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>PH (standard unit)</td>
<td>6.0-9.5</td>
<td>6.0-9.0</td>
<td>Monthly</td>
</tr>
<tr>
<td>Total Suspended Solids (mg/l)</td>
<td>50 or less</td>
<td>25 or less</td>
<td>Quarterly</td>
</tr>
<tr>
<td>Soluble Phosphorous (mg/l)</td>
<td>0.5 or less</td>
<td>0.3 or less</td>
<td>Monthly</td>
</tr>
<tr>
<td>Total ammonia nitrogen (mg/l)</td>
<td>5 or less</td>
<td>3 or less</td>
<td>Monthly</td>
</tr>
<tr>
<td>5-day BOD (mg/l)</td>
<td>50 or less</td>
<td>30 or less</td>
<td>Quarterly</td>
</tr>
<tr>
<td>Dissolved Oxygen (mg/l)</td>
<td>4 or more</td>
<td>5 or more</td>
<td>Monthly</td>
</tr>
</tbody>
</table>


Table 14 indicates the water quality monitoring values for Lakes and Reservoirs. Calculation for load indices nitrogen and phosphorus imposed by cages and net pens on receiving water bodies can be estimated as follows:

Nitrogen load (kg/yr.) = \[\text{Total feed (kg) x Nitrogen (% in feed) ÷ 100} - \text{Harvested fish (kg) x Nitrogen (% in feed) ÷ 100}\]

Phosphorus load (kg/yr.) = \[\text{Total feed (kg) x Nitrogen (% in feed) ÷ 100} - \text{Harvested fish (kg) x Nitrogen (% in feed) ÷ 100}\]

Nitrogen load index (kg/ton fish) = Nitrogen load (kg/yr.) ÷ Fish production (ton/yr.)

Phosphorus load index (kg/ton fish) = Phosphorus load (kg/yr.) ÷ Fish production (ton/yr.).

The percentage nitrogen in feed is percentage crude protein divided by 7.25. The phosphorus content in tilapia feed is about 1%, but the exact value should be measured or obtained from the feed manufacturer. Live tilapia typically contains 2.2% nitrogen and 0.72% phosphorus.

Table 14: Water Quality Monitoring in Lakes and Reservoirs with Tilapia cage or net pen culture

<table>
<thead>
<tr>
<th>Variable</th>
<th>Sample depth</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temperature</td>
<td>Vertical profile-1m int.</td>
<td>Monthly</td>
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<tr>
<td></td>
<td>(\text{(Min 20^\text{o}C Max 30^\text{o}C)})</td>
<td></td>
</tr>
<tr>
<td>Dissolved Oxygen (mg/l)</td>
<td>Vertical profile-1m int.</td>
<td>Monthly</td>
</tr>
<tr>
<td></td>
<td>(\text{(greater than 3mg/l)})</td>
<td></td>
</tr>
<tr>
<td>pH</td>
<td>Equal to cage mid-depth</td>
<td>Quarterly</td>
</tr>
<tr>
<td></td>
<td>(\text{(Min 6 Max 9)})</td>
<td></td>
</tr>
<tr>
<td>Chlorophyll (\alpha)</td>
<td>Equal to cage mid-depth</td>
<td>Quarterly</td>
</tr>
<tr>
<td></td>
<td>(\text{(Sechi reading \gg 20cm)})</td>
<td></td>
</tr>
<tr>
<td>5-day biochemical oxygen demand</td>
<td>Equal to cage mid-depth</td>
<td>Quarterly</td>
</tr>
<tr>
<td>Secchi disk visibility</td>
<td>&gt;6</td>
<td>Weekly</td>
</tr>
<tr>
<td>Soluble phosphorous</td>
<td>Equal to cage mid-depth</td>
<td>Quarterly</td>
</tr>
<tr>
<td>Total ammonia nitrogen</td>
<td>Equal to cage mid-depth</td>
<td>Quarterly</td>
</tr>
<tr>
<td>Phytoplankton abundance and species</td>
<td>Equal to cage mid-depth</td>
<td>Quarterly</td>
</tr>
</tbody>
</table>


Only a portion of the nutrients added to aquaculture facilities to increase production is converted to animal tissue. The remainder becomes waste that can cause increased concentrations of nutrients, organic matter and suspended solids in and around culture systems. Land-based farms discharge
effluents during water exchange or when production facilities are cleaned or drained for harvest. Wastes from cages and net pens pass directly into the receiving water bodies. Effluents can contain nitrogen, phosphorus, suspended solids and organic matter at greater than ambient concentrations. The substances in effluents can contribute to eutrophication, sedimentation and high oxygen demand in receiving water. Effluents with low dissolved oxygen concentrations or high pH can negatively affect aquatic organisms in receiving water bodies. The suggested frequency of monitoring these values is given in Table 12. The suggested sampling procedure for cage culture is as follows:

- A minimum of three sampling stations shall be established. One shall be in the approximate centre of the cage farm or net pen area. The other two stations must be at least 200 m and preferably 500 m away from the cages, in the direction of the predominant wind. The evaluator must approve the locations of the stations.

- Water shall be collected with a Kemmerer or van Dorn water sampler, or by use of a weighted bottle from which the stopper can be removed by jerking the calibrated line. Samples shall be transferred to clean plastic bottles and placed on ice in a closed, insulated chest to avoid exposure to light.

This standard is designed to demonstrate that compliance with other BAP standards through the application of good management practices is effective in reducing the volume and improving the quality of farm effluents. The water quality criteria also assure that effluents from aquaculture facilities have no greater concentrations of pollutants than typically allowed for effluents from other point sources. Where possible, farms should adopt practices that reduce effluent volume, such as harvesting by seining rather than draining, and maintaining water quality by mechanical aeration rather than pond flushing. Applicants in the BAP programme shall maintain records for effluent data. To confirm compliance with BAP water quality criteria at farms, the evaluator will sample effluents during the inspection process and have them analysed by an independent laboratory.

For land based farms, the following sampling schedule is suggested.

- Samples shall be collected near the point where effluents enter natural water bodies or exit the farm property. A water control structure at the sampling site or suitable sampling method should be used to prevent mixing of effluent and water from the receiving body.

- For farms with multiple effluent outfalls, all or several outfalls shall be sampled to prepare a composite sample for analysis. Where there are more than four outfalls, three outfalls shall be selected as sampling locations.

- Water shall be collected directly from the discharge stream of pipes or dipped from the surface of ditches or canals with a clean plastic bottle. The sample will be placed on ice in a closed, insulated chest to prevent exposure to light.

- Samples or direct measurements for temperature, dissolved oxygen and pH shall be obtained between 0500 and 0700 hours, and 1300 and 1500 hours on the same day. The average of the two measurements for each variable will be used for verification of compliance.

- Samples for other variables shall be collected between 0500 and 0700 hours.
• The number of ponds or production units being drained for harvest at the time of sampling shall be recorded.

• Source water samples shall be collected quarterly directly in front of the pump station or from the pump discharge outlet but before pumped water mixes with the supply canal. These samples enable the calculation of annual loads (Equation 2 below) and establish if the limited option is applicable.

According to BMPs the analyses of results will be carried out by a competent private or government laboratory according to the following guidance:

• The Hach and Merck water analysis equipment is approved for total ammonia nitrogen, soluble phosphorus, and chloride analyses. However, evaluators can reject analytical results if sampling, in situ measurements or lab protocols are deficient.

• Measurements for temperature, dissolved oxygen and pH shall be taken in situ with portable meters. Evaluators must verify the correct application of calibration procedures.
<table>
<thead>
<tr>
<th>Issue</th>
<th>Impact</th>
<th>Mitigation/Management</th>
<th>Time Frame</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nutrient enrichment</td>
<td>Exceeding the critical level or load ($L_c$) would lead to a eutrophic state in the lake and such state reduces light penetration into the waters</td>
<td>- Establish effluent ‘rapids’ so as to increase oxidation of nitrogenous matter   - Monitor feed rates to avoid overfeeding   - Installation of settling ponds to capture of sediment, organic matter and other pollutants by deposition, infiltration, absorption, decomposition and volatilization</td>
<td>During and after project implementation</td>
</tr>
<tr>
<td>Disposal of waste</td>
<td>- contamination of environment</td>
<td>- Fertiliser production   - Pet food production   - Primary treatment of factory effluent   - Effluent passing through settlement ponds   - Incineration of protein waste</td>
<td>Throughout project</td>
</tr>
<tr>
<td></td>
<td>- attracting scavengers</td>
<td>- Fertiliser production   - Pet food production   - Primary treatment of factory effluent   - Effluent passing through settlement ponds   - Incineration of protein waste</td>
<td>Throughout project</td>
</tr>
<tr>
<td></td>
<td>- injuring wildlife</td>
<td>- Fertiliser production   - Pet food production   - Primary treatment of factory effluent   - Effluent passing through settlement ponds   - Incineration of protein waste</td>
<td>Throughout project</td>
</tr>
<tr>
<td></td>
<td>- spreading diseases</td>
<td>- Fertiliser production   - Pet food production   - Primary treatment of factory effluent   - Effluent passing through settlement ponds   - Incineration of protein waste</td>
<td>Throughout project</td>
</tr>
<tr>
<td></td>
<td>- emission of odours (air pollution)</td>
<td>- Fertiliser production   - Pet food production   - Primary treatment of factory effluent   - Effluent passing through settlement ponds   - Incineration of protein waste</td>
<td>Throughout project</td>
</tr>
<tr>
<td></td>
<td>- waste water treatment plant efficiency</td>
<td>- Fertiliser production   - Pet food production   - Primary treatment of factory effluent   - Effluent passing through settlement ponds   - Incineration of protein waste</td>
<td>Throughout project</td>
</tr>
<tr>
<td>Flow regimes/water currents</td>
<td>- Water flowing through the cages is affected by drag forces exerted by the framework and netting</td>
<td>- Jump nets that extend above the water line should be constructed to prevent overtopping by storm surges or waves   - Install cages away from major rivers, areas with aquatic vegetation</td>
<td>During and after project implementation</td>
</tr>
<tr>
<td></td>
<td>- Increase in the rate of waste accumulation in the immediate cage vicinity</td>
<td>- Jump nets that extend above the water line should be constructed to prevent overtopping by storm surges or waves   - Install cages away from major rivers, areas with aquatic vegetation</td>
<td>During and after project implementation</td>
</tr>
<tr>
<td></td>
<td>- Disruption of the dispersion of sediments carrying plume from the underneath large rivers</td>
<td>- Jump nets that extend above the water line should be constructed to prevent overtopping by storm surges or waves   - Install cages away from major rivers, areas with aquatic vegetation</td>
<td>During and after project implementation</td>
</tr>
<tr>
<td>Issue</td>
<td>Impact</td>
<td>Mitigation/Management</td>
<td>Time Frame</td>
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</tr>
</tbody>
</table>
| Fish mortalities | - Bacterial action and autolysis of dead fish results in the excretion of ammonia in lake waters  
- Live fish preying on dead fish can result in the spread of diseases if the corpse died of a disease  
- Mortalities attract fish predators e.g. birds, in the farm and birds, crocodiles at the cages | - Conduct a daily routine of collecting mortalities on the farm  
- All mortalities should be burnt at the incinerator | Throughout the project life cycle                                                                |
| Pond effluent   | - Increase in accumulation of waste in the lake hence affecting the bottom dwelling organisms  
- Increase in phytoplankton productivity  
- Organic anions may become a part of the total alkalinity in polluted waters | - Introduction of the hapas system minimizes the rate of nutrient loading from the draining ponds  
- Reduce rate of disposal by minimizing draining of ponds  
- Settling ponds retains effluent for 76 hrs allowing the waste to sink allowing for breakdown and hydrolysis of organic matter  
- Anaerobic bacteria in the settling ponds which hydrolyses organic matter  
- Ensure that the inlet and discharge points are independent from each other so as to guarantee that water supply and effluent do not mix | Throughout the project life cycle                                                                |
| Fish feed waste | - Uneaten feed accumulates as waste and produces ammonia as it decomposes in the ponds  
- Uneaten feed accumulating at the bottom of the cages where it is synthesized and sinks to the bottom to be | - Feed on response to avoid overfeeding  
- Practice regular flushing of ponds/tanks  
- Adjust feed chart in winter to avoid overfeeding and unnecessary feed loss  
- Monitor feed for macro-minerals like phosphorus and nitrogen  
- Use of extruded feed to improve on digestibility and reduce the amounts of feed lost to the | Throughout the project life cycle                                                                |
<table>
<thead>
<tr>
<th>mineralized by bacteria</th>
<th>environment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Feed contains some macro-minerals which are possible pollutants of the environment</td>
<td>- Anchoring of cages on single paint moorings so that waste will be distributed over greater area</td>
</tr>
<tr>
<td>Increase in levels of ammonia, nitrogen and phosphorus in lake waters</td>
<td>- Increase feed use efficiency by using high-quality feed that contains desired nitrogen and phosphorus minerals and by assuring that fish consume most of the feed offered</td>
</tr>
<tr>
<td>Waste can accumulate beneath cages and cause deterioration of water quality, which can have a negative impact on the fish in cages</td>
<td>- Fallowing of are below cages to allow the breakdown of accumulated waste</td>
</tr>
<tr>
<td>Fish escapes</td>
<td>- Apply appropriate feed type and size suitable for a specific stage of fish</td>
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<td></td>
<td>- Install screens on all inlet and outlet points in the fish farm to minimize the escape of fry, juveniles and brood stock</td>
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<td></td>
<td>- Filter screens in fish farm shall be designed to retain the smallest life stage present</td>
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<td></td>
<td>- Filter devices should be capable of screening all water</td>
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<td></td>
<td>- Cages should be made of sturdy, non-corrosive material</td>
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<td></td>
<td>- Make through inspection of nets before they are deployed so as to avoid possible escapes from the cages</td>
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<tr>
<td></td>
<td>- Follow protocols when transferring, changing nets or harvesting fish from the cages e.g. use of fish boxes</td>
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<tr>
<td></td>
<td>- Divers or underwater cameras must periodically inspect cages for holes, rips or tears</td>
</tr>
<tr>
<td>Issue</td>
<td>Impact</td>
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<tr>
<td>----------------------------</td>
<td>------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Fish diseases</td>
<td>- Spread of diseases to wild populations</td>
</tr>
<tr>
<td></td>
<td>- Evolution of drug resistant fish pathogens</td>
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<td></td>
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<tr>
<td>Predator/prey interactions</td>
<td>- Fish losses to predation</td>
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<tr>
<td>Road access congestion</td>
<td>- Road deterioration</td>
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<tr>
<td>Food hygiene</td>
<td>- Spread of diseases</td>
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<tr>
<td>Health issues and</td>
<td>- Accidents in factory</td>
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<tr>
<td>occupational safety</td>
<td></td>
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<tr>
<td>Bio-safety measures for</td>
<td>- Disease outbreak</td>
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<tr>
<td>factory</td>
<td>- Health challenges due to large workforce</td>
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<tr>
<td>Health service</td>
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<tr>
<td>Encroachment into</td>
<td>- Reduction of Kapenta fishing grounds</td>
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<td>kapenta fishing grounds</td>
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<tr>
<td>Conflict with other lake</td>
<td>- Reduce space for other users</td>
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<tr>
<td>users</td>
<td></td>
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<tr>
<td>Navigational requirements</td>
<td>- Boat accidents at night</td>
</tr>
<tr>
<td>Aesthetic value</td>
<td>Cages and lake based fish feed storage facilities change the natural scenery of the area</td>
</tr>
<tr>
<td>Employment opportunities</td>
<td>Production is likely to reduce the price of capture fish and fishers incomes</td>
</tr>
<tr>
<td>Activity</td>
<td>Problem</td>
</tr>
<tr>
<td>--------------------------------</td>
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</tr>
<tr>
<td>Farm design, site selection</td>
<td>Habitat preservation</td>
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<tr>
<td>and construction</td>
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<tr>
<td>Production cages</td>
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<tr>
<td>Nutrient control</td>
<td>Production cages</td>
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<tr>
<td>Operations</td>
<td>Over-feeding</td>
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<tr>
<td>Overcrowding</td>
<td>Production cages</td>
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<td>Activity</td>
<td>Problem</td>
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<tr>
<td>Disease prevention</td>
<td>Production cages</td>
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<tr>
<td>Excess organic nutrients</td>
<td>Production cages</td>
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<tr>
<td>Predation</td>
<td>Production cages</td>
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10.7 Rules of Compliance to Best Management Practice

The rules of compliance with Best Aquaculture Practice for effluent discharge standards differ among production methods production of Tilapia. The rules for compliance with best management practice for ponds and cages are given as follows.

For land-based farms, at least three months of effluent data are required for initial farm compliance. For each variable measured monthly, at least 10 values obtained during a 12-month period shall initially comply with the criteria. After five years, the target is no more than one annual case of noncompliance for each variable. For variables measured quarterly, one noncompliance is initially permitted for each variable during a 12-month period. The target after five years is no more than one case of noncompliance for each variable during a 24-month period. When non compliances occur, farms should make every effort to correct the problems within 90 days.

Floating cages may be installed in lakes, reservoirs, streams, irrigation systems, ponds or estuaries. They discharge effluents in form of uneaten feed, fish faeces and metabolic excretions of fish. Rules for compliance with the Best Aquaculture Practice effluent standard differ among the types of water bodies in which the cages and pens are installed. Moreover, natural water bodies can already be eutrophic when compliance is sought. Sites at which water quality in the water body containing cages or net pens does not comply with Best Aquaculture Practice effluent guidelines shall not be eligible for compliance.

Yalelo Ltd aims at meeting compliance rules by adhering to the Best Aquaculture Practice effluent discharge standards for Cage Aquaculture methods of production for Tilapia in Lake Kariba.
11.0 Conclusion

This project is economically, environmentally and socially justified. Economic justification rests on its contribution to fish food production to the extent of replacing the current level of imports. It is socially acceptable because it will provide employment to a number of persons that are currently unemployed, open up a marginalised region to development and provide alternative livelihood to fishers and other smallholder farmers through its out-grower scheme involving 1,000 smallholder fish farmers. The project will employ best aquaculture management practices and in order to minimise negative impacts on the environment. Because of this the project is not only socially acceptable; it is economically viable and therefore environmentally sound and sustainable. The project EIS report merits approval.

The report considers a number of options with regard to location, farming system and species in use. The conclusion is that Kamimbi bay, where Yalelo cages will be placed, is one of the sites identified by the National Aquaculture Development Programme for development of cage culture in Siavonga district. Among the seven sites reviewed, Kamimbi is preferable because it is far enough from Siavonga where there is risk of increased pollution in future and possibility of larceny on the culture facility as banana bay, the closest of the sites identified to Siavonga. At the same time it is not too far as to access the supplies from Siavonga.

Kamimbi is also preferred because the area does not have conflicts with tourism industry located around the Township. Therefore, Yalelo has positioned itself in the best cage culture zone in Zambia by locating its project in Kamimbi. The development of the project in this area is appropriate in all aspects of natural conditions for cage culture and therefore deserves support.

The study also reviewed alternatives to Nile Tilapia and concluded that the species is suitable to the environment because it is already present in the natural environment of the Lake. The project will not introduce a new species. Other alternative species are economically risky and should not be tried for a Greenfield project as Yalelo’s.

Cage culture option is preferred because the technology is more cost effective than ponds in terms of land requirements and total investments. Fishpond alternative is rejected in preference for cage culture because the later is associated with less discharge of waste into the environment. In addition, because the project will use locally available species, feed and fertilisers, it has positive spill over to other input suppliers and therefore good for the development of the economy.

The wastes generated by the project have minimal impacts on the environment. This is because of the mitigation measures provided and also because most of the solid wastes to be generated by the fish processing operation will be processed further to produce fish meal and fish oil for use in other industry. It should be noted that Zambia is a net importer of fish meal and oil which the project will also produce in addition to table fish. Furthermore, the socio-economic impacts of the project are largely positive, while negative impacts are minimal. These impacts are adequately avoided through a number of company policies and practices. Only 8 families have been displaced by the project and mutually acceptable compensation terms and amounts agreed. In addition a project impact management and monitoring framework has been proposed. The project has no unavoidable impacts and therefore merits support.
12.0 References

4. C. M. & Roest, F. C. (eds) Current Status of Fisheries and Fish Stocks of the Four Largest African
Appendix 1: Chiefs Consent Letter

14th December, 2011

The Acting Council Secretary
Siavonga District Council
P.O. Box 12
SIAVONGA,

Dear Madam,

RE: LAND ALLOCATION IN KAMIMBI-YALELO LIMITED

Be advised that the piece of land (110ha) has been given to the company mentioned above for the development of fish farming project and other related activities in Kamimbi area.

Your usual and kind cooperation will be highly appreciated in assisting them to get other documents needed in order for them to start the project as soon as they are more than willing to develop it.

May Almighty God bless you abundantly.

Stay well,

His Royal Highness Chief F. M. Simamba the XI
BAGANDE Palace, Box 67, Siavonga, Zambia

Simamba Chiefdom
Chief Simamba
Appendix 2: Yalelo Farm Site
Appendix 3: Yalelo HIV/AIDS Policy

Yalelo Limited

HIV/AIDS Policy

Policy statement

The company recognises the gravity and implications of the AIDS epidemic for the individuals who are infected, their families, the company, its employees and the co-workers of affected individuals.

The company commits itself to addressing HIV/AIDS in a positive, supportive and non-discriminatory manner and seeks to minimise the social, economic and developmental consequences of this epidemic to both the company and its employees.

The HIV/AIDS policy detailed below provides clear guidelines to both employees and management.

i. Education and information
   a. All company employees should be informed and educated about HIV/AIDS through ongoing multimedia education and information programmes; for example workshops, awareness programmes and presentations, condom distribution, pamphlets and posters.

   b. The education and information programmes will be administered by the company’s department managers, HQ managers, health practitioners, human resources practitioners and facilitators, who have been taught HIV/AIDS education and training programmes.

   c. The objectives of the education and information programmes are:

      i. Communicating basic knowledge about the disease and its prevention
      ii. Building community acceptance of persons living with HIV/AIDS to avoid feelings of rejection and isolation and to de-stigmatise HIV infection.
      iii. Providing information to employees about voluntary counselling and testing within the organisation, about wellness programmes and medication available, about coping with work performance and what happens when employees are too sick to work, and about employee benefits on medical incapacity termination of services.
      iv. Protection of employees potentially exposed to HIV in their duties.

   d. HIV/AIDS educational material and programmes are to be made available to all employees in Yalelo.

   ii. Confidentiality

   Employees living with HIV or AIDS have a right to confidentiality and privacy concerning their health records. Employees are encouraged to undergo voluntary counselling and testing through registered medical facilities and thereafter where appropriate to enrol
in a supportive health programme. The company will support employees in this. The employees HIV status is confidential within the medical department and will not be divulged unless an employee gives written consent to this.

**Employee assistance**

The company’s HIV/AIDS Committee in conjunction with external HIV/AIDS counsellors are available to provide employees with appropriate counselling services. Employees may also wish to speak informally with colleagues as a first step. Peer educators will be trained to assist with informal education and dissemination of information on HIV/AIDS, and members of senior management across departments will be trained as counsellors as well. Voluntary counselling and testing together with a supportive health programme are available to employees and dependants.

**iii. HIV testing**

a. **Pre-employment testing**
   The company does not conduct pre-employment testing for HIV/AIDS. Medical testing either before commencing or during employment, which is subject to the consent of the individual concerned, shall assess current functional performance and prognosis with regard to fitness for work. HIV screening may be conducted as part of the selection criteria for long term training periods for example sponsorship of a degree course coupled to a service obligation.

b. **Voluntary confidential HIV testing**
   Voluntary confidential HIV testing with pre- and post-test counselling, shall be available to all employees. Results shall remain confidential and employees who have been tested HIV positive shall have access to continuing support and health services. No employee shall be forced to undergo testing for HIV.

c. **Pre-benefit testing**
   In the event that the providers of risk benefits, i.e. health insurance companies, require HIV testing, it shall be for underwriting purposes only and requested by insurance companies. Such underwriting requirements do not affect the company’s policy regarding testing.

iv. **No unfair discrimination against HIV/AIDS employees**
   The company shall not practice any unfair discrimination against employees infected with HIV/AIDS. These employees will be treated in the same way as all other employees, and will be assisted by the company through counselling, and access to medical care, to maintain their health and therefore their capacity to be effective employees for as long as possible.

v. **Working with employees living with HIV/AIDS**
   Working with and alongside employees who are HIV positive or who have AIDS is taken as a given in YALELO, where the infection rate likely to be in excess of 18% or roughly one in five employees, due to the high proportion of formerly mobile fisher men and women from fishing communities. The company wishes to foster a caring environment which supportsthesse workers. If an employee discriminates against a co-worker due to
the co-worker's HIV status, or assumed HIV status, this will result in disciplinary action. Please see Yalelo’s disciplinary policy for further information on this process.

The company further commits itself to inform and prepare employees on the realities of working with colleagues living with HIV/AIDS. The company recognises that all employees have the right to a safe work environment. The company is therefore committed to provide information to all employees and to establish widespread procedures regarding universal precautions to prevent HIV infection in the workplace. These procedures should be followed at all times in case of an injury at work.

**Employee benefits**

Employees who are infected with HIV or who have developed AIDS are entitled to their normal employee benefits while in regular employment. Adjustments to salary or conditions of service which follow re-assignment to alternate duties are normally agreed with employees. Company policy on ill-health retirement includes all ill health retirements irrespective of the cause, and no special conditions exist for employees with HIV/AIDS which places them at a disadvantage relative to others.

**vi. Performance and termination of services**

All employees, whether infected with HIV/AIDS, or any other medical condition, are subject to performance requirements in their jobs. For as long as an employee is capable of rendering services effectively at the required performance standard, there is no reason to differentiate between these and other employees. Where an employee is unable to meet the performance requirements of his/her work due to illness, the employee’s services may be terminated on the grounds of incapacity.

Within the workforce there will be ill employees who know their HIV/AIDS status and there will be ill employees who do not. There will be those who have undergone voluntary counselling and testing at the company and those who have not. The company will not unfairly discriminate between any of these groups but will adopt a fair and caring approach which seeks to be objective in the evaluation of employees’ ability to render effective service, and which attempts to provide appropriate medical and counselling support while they are ill.

Where the company believes an employee is no longer capable of effectively performing his/her normal duties due to ill health of any nature, or where an employee has made representations to management that they are unable to cope, the company will consider if there are any suitable vacancies for the employee in which the employee could reasonably be able to perform. If such alternative employment is available the employee will be offered the position at the conditions of service appropriate for that job. If there are no suitable alternative employment opportunities available, or if the employee turns down the offer of alternative employment, then the employee’s services will be terminated on the grounds of medical incapacity. Termination will be in accordance with Zambian labour law and individual employment contracts.

**vii. Grievance/disciplinary procedures**

Non-compliance with the guidelines set out in this policy is treated in terms of the company’s grievance and disciplinary procedures.
viii. Policy review

This policy will be reviewed from time to time in order to reflect changes in legislation as well as medical, academic, occupational and employment developments with regard to HIV/AIDS.

ix. Further information

If you have any queries about the HIV/AIDS policy or education programmes, please contact:

Mr. Albert Nsonga

COO and Siavonga Site Manager

0973515602

0978006280
Appendix 4: Community Led HIV/AIDS Response Framework

The Community Led HIV/AIDS Response Framework

The entry point of Yalelo HIV/AIDS prevention in the community of Kamimbi and Namachembele is through the Company HIV/AIDS workplace policy. This is in-line with GRZ policy on HIV/AIDS response which focuses on a multi-sectoral approach to the pandemic. Yalelo will support such a community led HIV/AIDS response. This is because the seriousness of the pandemic remains pervasive, there is therefore need to leverage additional resources to stop it. In spite of the best of efforts, the Demographic Health Survey (2007) has information that suggests that the majority of citizens still do not have adequate access to:

- HIV/AIDS information and education
- Prevention methods
- Care and treatment
- Protection from stigma and discrimination
- The right to negotiate safe sex
- Livelihood without risking unsafe sex

The community led response to HIV/AIDS pandemic is warranted because HIV/AIDS it is not simply a health problem - it ravages whole communities, deepens poverty and has the potential to threaten the stability of the entire nation.

The expectation from multi-sectoral approaches to HIV/AIDS pandemic is that it is possible to bring it down through holistic economic and social development approaches. This suggests an understanding and response that incorporates the relationship between HIV/AIDS and poverty, gender inequity, economic opportunity and stigma that is rooted in cultural traditions. Some of the responses that have been tried around the world, including Zambia include the following areas of support.

1. Making HIV/AIDS prevention and care a human right
2. Ensuring that PLWA are cared for and protected from stigma and discrimination
3. Supporting children affected by AIDS to ensure that they are nurtured and educated
4. Strengthening leaders' and groups' skills and capacities to cope with HIV/AIDS
5. Inspiration of hope and planning for the future
6. Networking and coordinating HIV/AIDS activities in districts

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7. Voicing the unspeakable (challenging stigma).

8. Helping women and youth to generate income for more life-saving choices and control in their lives.

9. Advocacy for prevention, care and treatment in partnership with government and the private sectors

10. Working with the media to get the word out and get people the information they need to cope.

This is a broad menu of approaches and entry point for supporting community led response to HIV/AIDS pandemic in Kamimbi and Namachembele Village. The intervention gives supports to each member of the community to take on different roles in the community engagement process, which builds on their individual experience and strengths and coordinates activities in order to:

1. Mitigate the impact of stigma and discrimination on prevention, treatment, care, and support;

2. Increase community awareness and understanding of available HIV services;

3. Increase access to and use of services through referral systems and support;

4. Increase community understanding of the connections between prevention, care, and treatment;

5. Support individuals in successful use of treatment and preventive behaviours; and

6. Support health care workers in delivering services and ensuring that their own health needs are met.

The community engagement process works well where all the key stakeholders involved in the process are gender balanced and typically include:

- Local health centre and HIV clinic staff;
- Networks of HIV-positive people including children and young people affected by HIV;
- Networks of marginalised groups (such as sex workers);
- Local decision-makers (such as councils and health committees);
- Home-based care providers;
- Youth leaders and young people themselves;
- School teachers and parents' representatives;
- Traditional leaders, educators, and healers;
- Pastors and others with moral and spiritual influence in the community; and
• Local employers and businesses such as pharmacies, where these are present.

This is the experience of the Zambia the Antiretroviral Treatment, Community Education, and Referral (ACER) project that has pioneered the Alliance approach since 2004. A referral system operates between home-based care providers, positive people’s networks, traditional healers, youth groups, and antiretroviral (ARV) and health clinics. Treatment supporters, openly living with HIV, work in ARV clinics and coordinate partner activities in the community. This has encouraged high levels of treatment adherence, low drop-out rates, and reduced stigma. This approach has also been tried in other African countries and the Caribbean with similar results.

There is emerging consensus that HIV/AIDS prevention is achieved when communities are able to assess and respond openly to the factors that may put themselves and their community at risk of HIV. In order to bring this about, communities, NGOs, government service providers, policy makers, donors, and research institutes all need to work towards a shared vision as equal partners. Yalelo will have to position itself within this process of change, looking to clarify its role in the coalition, and to implement that role effectively. Inevitably, this is a long haul because time will have to work through to allow the partnerships within the network to evolve and inform actions of change.

For this process to form and produce early results the community will cease to be a passive recipient of action plans. This is possible if the change agents can develop a structure within this community that places community members on an equal footing with other partners and allows more meaningful, and rational involvement of the community in decision-making.

If communities can be seen as the heart of the process, it is the individual members of communities that allow it to function. One definition of a community is a group of individuals who are bound together by common interests. But, whilst the community might be a harmonious entity with a set of shared ideas and principles, it can also embody the desires and rights of the powerful, reinforced by local traditions and laws. Thus, to avoid the domination of a powerful minority, the full and active participation of all members of communities, including the most marginalized, is critical. This is not simply because it is everyone’s right to be involved in decisions and actions that impact on their lives: it is because ignoring the rights and needs of vulnerable or marginalized people is likely to undermine the relevance and sustainability of such change processes. The PLHA, young people, mobile populations, poorer people and women need to be actively encouraged to participate in community-led change.

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http://www.pactworld.org/cs/community_led_response_to_aids
Even though there can be no universally agreed definition of a community led response to HIV/AIDS, there is an agreement that a multi-sectoral response strategy that works is characterised by change from response from need to response to rights. People are no longer simply beneficiaries, but become entitlement-bearers and duty-bearers responsible for their own change processes. People cease to be subjects of change and become movers and promoters of the change they want. This paradigm shift is represented by the diagram below.

<table>
<thead>
<tr>
<th>Change from</th>
<th>Change to</th>
</tr>
</thead>
<tbody>
<tr>
<td>Responding to need</td>
<td>Responding to individual’s rights</td>
</tr>
<tr>
<td>People as beneficiaries</td>
<td>People as entitlement-bearers and duty-bearers responsible for their own change processes</td>
</tr>
<tr>
<td>Community involvement</td>
<td>Individual, group and community capacity to change their own lives and improve their own communities.</td>
</tr>
<tr>
<td>Target-led approaches</td>
<td>Process-led approaches such as social exclusion analysis and stepping-stones, rather than externally conceived “quick fixes” and imported technical models</td>
</tr>
<tr>
<td>Time-bound internal reflection</td>
<td>Continuous process of learning, action and reflection on lessons learned</td>
</tr>
<tr>
<td>An advisory role as expert</td>
<td>A sharing role as partner</td>
</tr>
</tbody>
</table>
Appendix 5: Resettlement Action Plan

Yalelo Limited

Resettlement Action Plan (“RAP”)

1) Introduction and Background

The Yalelo Limited is an operating aquaculture company, situated in Namachembele and Kamimbi area, of Kariba Ward of Siavonga District in Zambia. This area is 25 kilometres west of Siavonga town. Yalelo Limited’s current operations are compliant with the company’s Environmental Project Brief dated May 3rd 2012 which was approved by Zambian Environmental Management Authority.

Yalelo plans to farm up to 7,000 tonnes of Oreochromis niloticus (commonly known as Tilapia or Bream) annually in 20 and 25 meter diameter floating cages on Lake Kariba by 2013. Yalelo’s aim is to be a leading example of environmental and social best practice within the Zambian aquaculture industry and also to demonstrate the viability of large-scale sustainable fish production using Zambian resources. The project, when fully implemented will assist in offsetting the large deficit of affordable fish within Zambia and contribute significantly to the development of a rural economy of Siavonga through provision of over 260 new jobs.

It is estimated that Zambia currently produces 85,000 tonnes of fish per year against an estimated demand of 145,000 tonnes. It is further estimated that approximately 6,000 tonnes of fish is currently being imported annually from China, India and Zimbabwe. The majority of imported fish is consumed in cities and townships of Lusaka and Copperbelt provinces, especially during the annual fishing ban from December to March. Yalelo’s contribution will replace current imports through locally produced fish, thus increasing national food security and achievement of the national development objective to increase production of farmed fish.

1.1) The Need for a Compensation Plan

In order to enable safe development of the Yalelo farm and associated infrastructure and services, as well as to comply with Town and Country Planning Land Use Regulations, it is necessary to displace nine resident families from parts of Yalelo’s farm, predominately the South East corner within a 75 meter square area. Following a comprehensive survey of the plot to endure all residents were identified, a public meeting was held on 12th May 2012 in Kamimbi Village to discuss this topic. The meeting was informed that Yalelo would like to agree on an outcome which did not unwillingly displace individuals living on the land alienated to Yalelo. The meeting called on Yalelo to facilitate resolution of this matter as soon as possible and willingly assist whosoever is in need of assistance.
The key objectives of this meeting were to:

- Inform stakeholders of Yalelo activities
- Consult and educate stakeholders on all aspects of the Project
- Collect community inputs which can be incorporated into Project design and development
- Generate and document broad community support for the Project
- Improve communications between interested parties
- Document development of formal public consultation
- Describe formal complaint submittal and resolution mechanisms
- Disclosure of project documents.

2) **Policy, legal, and administrative framework for resettlement and compensation issues.**
There are various pieces of legislation that provide guidance regarding legal provisions for resettlement/compensation in Zambia.

(1) Constitution of Zambia, Chapter 1 of the Laws of Zambia, Article 16 of the Constitution provides for the fundamental right to property and protects persons from the deprivation of property. It states that a person cannot be deprived of property compulsorily except under the Authority of an Act of Parliament, which provides for adequate payment of compensation.

(2) Act No. 19 of 2000 (Arbitration Act) provides for arbitration in cases where the land owner/occupier does not agree with the amount of compensation being offered. Under section 12 (2) of the Act, the parties to arbitration are free to determine the procedure for appointing the arbitrator or arbitrators. Under section 12 (3) (b), if the parties are unable to agree on the arbitration, the arbitrator shall be appointed, upon request of a party, by an arbitral institution.

(3) Environmental Protection and Pollution Control (Environmental Impact Assessment) Regulations 1997 (No. 28 of 1997, promulgated under the Environmental Protection and Pollution Control Act Chapter 204 of the Laws of Zambia) Regulation 11 provides for the contents of environmental impact statements to include:

* The social economic impact of the project, such as resettlement of affected people;

* Socio-economic and cultural considerations such as effects on generation or reduction of employment in the area, social cohesion or resettlement, local economic impacts;

* Effect on land uses and land potential in the project area and surrounding areas

3) **Objectives**
The objectives for compensation are to:

1. Assist the displaced in improving their former living standards, income earning capacity, or at least in restoring them;
2. Provide assistance to affected people regardless of the legality of land tenure.
The relocated individuals will be moving to within 100 meters of their previous residence and within sight of their previous locations. Livelihoods were from livestock grazing and fishing. The Project Affected People’s livestock graze over a wide area and fishing takes place on the lake. As a result, livelihoods will not be disturbed by moving shelters within the immediate vicinity. Yalelo will assist the Project Affected People in moving their shelters (e.g. by providing a tractor and trailer, and assisting in reconstruction). Furthermore, Yalelo has agreed to the individuals request for monetary compensation. The basis for this compensation was on the value of the shelters, as determined by the Project Affected People themselves.

3.1) Identification of Project Impacts:

The RAP identifies all people affected by the project and all adverse impacts on their livelihoods associated with the project’s land acquisition.

Projected effects include:

• Loss of dwellings

• Loss of farm buildings, and other structures (wells, boreholes, fish ponds)

• Loss of institutional buildings/public facilities

• Loss of agricultural land, trees, and standing crops

• Impeded or lost access to community resources including forest and woodland

• Loss of business income during transition

• Reduced income resulting from these losses.

Economically displaced households are those whose livelihoods are impacted by the Project. This can include both resident households, and people living outside the Project Area but having land, crops, non-resident structures, businesses or various usage rights there. During Project development, consideration has been given to minimizing the scope of physical and economic displacement associated with the Project through:

• Design of Project Infrastructure

• Approaches to Land Access & Management.

In terms of design of project infrastructure, careful attention has been given to the following:

• Minimizing the size of Project components and the distances between those components

• Minimizing buffers around Project components

• Locating components of the Project footprint when feasible in less populated areas

• Minimizing loss of access as a result of Project infrastructure.

4) Valuation Procedure
The valuation procedure used was simple arithmetic and based on direct costs. The assessment was conducted by the Project Affected People themselves, whereby their estimated their costs of moving.

The results of the valuation process are tabulated in table 4.1. The costs used were related to the removal/construction of the structures, purchase of construction materials (predominately roofing sheets for shelter upgrades after moving) and loss of income during the removal and construction period (estimated at two days).

4.1) Project Affected Persons, structures involved and costs to be compensated

<table>
<thead>
<tr>
<th>Name of Beneficiary</th>
<th>Amount</th>
<th>Date of Moving</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alfred Simungulu</td>
<td>K1,500,000</td>
<td>September, 30 2012</td>
</tr>
<tr>
<td>Abed Simungulu</td>
<td>K1,500,000</td>
<td>September, 30 2012</td>
</tr>
<tr>
<td>Anteugoes Simungulu</td>
<td>K1,500,000</td>
<td>September, 30 2012</td>
</tr>
<tr>
<td>Abedinego Simungulu</td>
<td>K3,000,000</td>
<td>September, 30 2012</td>
</tr>
<tr>
<td>Webster Matiya</td>
<td>K1,700,000</td>
<td>November, 30 2012</td>
</tr>
<tr>
<td>Amos Gasa</td>
<td>K2,000,000</td>
<td>October, 30 2012</td>
</tr>
<tr>
<td>Charles Muleya</td>
<td>K3,000,000</td>
<td>September, 30 2012</td>
</tr>
<tr>
<td>Assizzio Simungulu</td>
<td>K2,000,000</td>
<td>September, 30 2012</td>
</tr>
<tr>
<td>Richard Simungulu</td>
<td>K2,000,000</td>
<td>September, 30 2012</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>K18,200,000</strong></td>
<td></td>
</tr>
</tbody>
</table>

The total amount to be compensated in kwacha terms is K18,200,000.00. The total number of people involved is nine. The issues identified for compensation are roofing sheets to rebuild houses. Houses are made from home-made bricks, which are available freely.

5) Institutional Framework and Disbursement Mechanisms

Since the Yalelo Limited has been handling this issue, it is suggested that the payments are made by Yalelo Limited in the presence of the Village Headman and local Chief. Those receiving the money will sign an official receipt at the time of reception of the compensation. The signed copies shall be included as substantiation of Yalelo’s expense. This mechanism of checks, balances and witnesses will avoid the misappropriation of resettlement funds.

6) Monitoring

The Project will conduct monitoring and evaluation to track the Resettlement Action Plan Implementation. The monitoring and evaluation will give particular attention to the project-affected communities, especially vulnerable groups and female headed households. Monitoring will be taken up internally by the Company to assess the success and identify potential difficulties and problem areas. Monitoring and evaluation have the following general objectives:

- Monitoring specific situations or difficulties arising from the implementation and compliance with objectives and methods set out in the Resettlement Action Plan
- Evaluating emergent, mid-and long-term impacts of the Project on the welfare of impacted households, communities, and local government
• Sufficient involvement of the project affected persons in participatory monitoring and evaluation of short term, mid-term and long term project activities and effects

7) Conclusion and Recommendations
Both the Project Affected People and Yalelo Limited believe this framework and agreement meets Zambian legal requirements and the objectives of:

1. assist the displaced in improving their former living standards, income earning capacity, or at least in restoring them;
2. provide assistance to affected people regardless of the legality of land tenure.

The resettlement process is expected to cause minimal disruption due to the small distance being moved, which is 100m and within existing sphere of culture and relationships. Adequate land is available within the surrounding region and Yalelo has emphasized to the Project Affected People that there is no hurry for them to move. The Project Affected People however are enthusiastic to move, in order to receive their proposed compensation.
Appendix 1: Site Plan and Project Affected People Location

Yalelo Limited
Siavonga Site Plan

Appendix 2: Photograph of Typical Shelter of Project Affected People
Appendix 6: Operational Health and Safety Guidelines
Yalelo Limited

Occupational Health & Safety:

Company policy and risk assessments

1. Introduction & statement of purpose

As part of normal business operations, Yalelo Limited is committed to providing as safe a working environment as could be reasonably expected for employees, visitors, and individuals in the vicinity of Yalelo’s operations. All employees of Yalelo take on some responsibility for ensuring such safety. This document provides an overview of some of the key activities that Yalelo employees are expected to engage in, and the safeguards and protections that should be in place.

Yalelo will always, as a minimum, maintain legal compliance on all issues relating to health and safety. Yalelo will always seek to improve standards where possible, and aim to achieve best practice within a positive health and safety culture. Yalelo will promote the participation of all employees in the continuous improvement of health and safety across all areas of the business.

2. General staff responsibilities

All employees are required to sign off on a copy of this document upon commencing employment, indicating they are understand and are familiar with the material within.

All employees should also always feel willing to report instances where they feel safety standards are not being followed or should be improved.

All employees are to receive training in evacuation procedures and basic emergency response procedures for the work sites which their duties will take them to.

Records of all training, including all varieties identified in Section 4, will be formally maintained, and re-assessments will be carried out on a regular basis.

To ensure best practise, Yalelo considers it crucial that all accidents and incidents that result in any injury, or “near-misses” that could potentially have resulted in injury, be recorded. Indeed, reporting such incidents can be considered part of the duties of employment; consequently failure to report is a form of employee misconduct. A template document, titled Yalelo Incident Recording Form, is available for this purpose from any management personnel at either Yalelo’s head office or the main site in Siavonga. The report should be filed with a management representative within three days of the incident occurring, and consequently lodged with Yalelo’s Office Manager at the head office two days after that.
Should a contractor, temporary employee, or visitor be injured, details of the incident should be recorded immediately using the same form by a member of Yalelo’s management team.

Upon an incident being recorded, senior management may decide whether or not to instigate a more detailed investigation, under discretionary terms. However, it is Yalelo’s policy that all accidents resulting in lost time or off-site medical treatment are investigated, with the purpose of properly identifying both the root cause of accident and any necessary remedial actions.

Note that, for the purposes of fulfilling its health and safety requirements, Yalelo will apply disciplinary procedures as appropriate, up to and including dismissal, for industrial misconduct. Examples of this include but are not limited to:

- Horseplay, fighting with or striking another individual
- Deliberate violation of safety standards or rules
- Reporting to work under the influence of any illegal substance or intoxicant which may have the effect of impairing work performance
- Deliberate and wilful damage to plant or equipment
- Misuse of safety equipment e.g. machinery guards, fire extinguishers and hoses
- Misuse of personal monitoring equipment

3. Specific staff responsibilities

Each level of management carries different levels of responsibilities. These are outlined below.

Chief Executive Officer

Ultimate responsibility for health and safety is that of the Chief Executive Officer. It is his duty to provide clear direction and guidance on health and safety policy and discharge his responsibilities to the Board of Directors.

Board of Directors

The Board of Directors is responsible for ensuring that the Company’s policy and arrangements concerning the safety, health and welfare of all employees are made known, implemented and maintained within their area of control. They are responsible for providing the necessary manpower, financial and other resources to support and effect this policy and will provide clear objectives, targets and key performance indicators for the Company and its personnel.

Senior Management
Senior Management are responsible for implementing the health and safety policies put in place within the Company. This will include ensuring that their employees at all levels have received sufficient health and safety training, time, money and resource to be able to undertake their duties effectively. They are responsible for overseeing the implementation of systems and procedures to shape and control the needs of the business.

Managers

Managers are responsible for ensuring that all aspects of health and safety are complied with in the areas they control. They are pivotal in communicating the policies implemented by the senior management team and the monitoring, implementation and guidance to the supervisory staff undertaking the tasks. Specifically, managers are required to:

- complete detailed accident investigations as required
- oversee the implementation of safety initiatives in their areas of responsibility, and provide resources and time to do so
- undertake workplace health and safety inspections in accordance with any agreed timescales
- work with other departments to maintain a safe and healthy work environment
- ensure sufficient supervisory support is provided to the workforce
- coordinate and times
- provide and assess training requirements for their workforce, to ensure all employees have suitable and sufficient training in order for them to undertake their duties safely and without risk to their health
- enforce safety rules and procedures and promote a positive health and safety culture
- report any defects that affect the health or safety of their employees
- undertake workplace inspections and the maintain hygiene standards

Employees

In addition to the general responsibilities identified in Section 2, employees at every level of the organisation all have the duty to ensure the health and safety of themselves and their fellow colleagues. All must act in a safe and responsible manner, use safety equipment provided to them appropriately, and follow specific instructions and training provided to them in the course of their work.
Health and Safety Manager

The Health and Safety Manager is responsible for the development, maintenance, and enforcement and auditing of Yalelo's health and safety policies and procedures. They are responsible for ensuring all staff are kept informed on occupational health and safety legislation development. They will provide support and assistance to all departments on health and safety issues as appropriate.

4. Community well-being

Yalelo recognises that health and safety issues in general are not just an internal company issue, but also impact on communities in the vicinity of a company's operations. For instance, it is conceivable that waste generated by fish cages could be ingested or otherwise affect nearby villages on the shores of Lake Kariba. Other impacts might include depletion of artesian aquifiers or reduction in the quantity of naturally occurring wildlife. Yalelo is committed in general to good environmental management and following the regulations and standards set by the relevant Zambian ministries, and as part of this will be regularly testing and monitoring its impact on the surrounding area.

However, in order to address any issues in a broader sense that may arise between Yalelo and the community, regular liaisons will occur between Yalelo’s CEO and local chiefs and councils. It is expected that these will serve as a formal means for locals to bring complaints to Yalelo’s attention.

5. Risk assessment

This document was prepared in February 2012, reflecting the activities Yalelo was undertaking at that time or expected to undertake shortly. As new activities are undertaken, further reviews should be conducted to identify additional risks, occurring at a minimum of once annually.

In all instances, Yalelo will follow any applicable regulation or legislation concerning its actions. Much of the bulk of this document is concerned with identifying the absolute minimum safety procedures that should be followed in a variety of situations. Note that this listing is not comprehensive. In all situations, employees are expected to use common sense, and make judgment calls regarding the appropriateness of an activity and the equipment available to do it. Clear communication on safety concerns is essential to good OH&S management.

As part of the risk assessment, potential accidents are classified by identifying both the likelihood of the accident occurring and the severity of the accident’s consequences in the event that it does occur. Our specific classification model is adopted from that provided by the International Finance Corporation [World Bank Group], with

---

likelihood classed in categories from rare to almost certain, and severity from insignificant to catastrophic. Note that these ratings are to some extent subjective.

### Table 1: Risk Classification

<table>
<thead>
<tr>
<th>Likelihood in terms of expected frequency of occurrence:</th>
<th>Insignificant (easily-healed cuts, scrapes, etc)</th>
<th>Minor (injury or disease requiring no more than a short period off work)</th>
<th>Moderate (injury or disease occasioning substantial time off work)</th>
<th>Major (single major injury or disabling disease)</th>
<th>Catastrophic (deaths and/or multiple major injuries)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Almost certain (weekly+)</td>
<td>L</td>
<td>M</td>
<td>E</td>
<td>E</td>
<td>E</td>
</tr>
<tr>
<td>Likely (monthly)</td>
<td>L</td>
<td>M</td>
<td>H</td>
<td>E</td>
<td>E</td>
</tr>
<tr>
<td>Moderate (bi-annual to annual)</td>
<td>L</td>
<td>M</td>
<td>H</td>
<td>E</td>
<td>E</td>
</tr>
<tr>
<td>Unlikely (between every one to five years)</td>
<td>L</td>
<td>L</td>
<td>M</td>
<td>H</td>
<td>E</td>
</tr>
<tr>
<td>Rare (every five years or more)</td>
<td>L</td>
<td>L</td>
<td>M</td>
<td>H</td>
<td>H</td>
</tr>
</tbody>
</table>

Key: E: extreme risk; unacceptable activity. H: high risk; senior management attention needed. M: moderate risk; management responsibility should be specified. L: low risk; manage by routine procedures.

As a general comment, preventive and protective measures should be introduced according to the following order of priority:

1. Eliminate the hazard by removing the activity from the work process. Examples include substitution with less hazardous chemicals, using different manufacturing processes, etc.

2. Control the hazard at its source through use of engineering controls. Examples include local exhaust ventilation, isolation rooms, machine guarding, acoustic insulating, etc.

3. Minimizing the hazard through design of safe work systems and administrative or institutional control measures. Examples include job rotation, training safe work procedures, workplace monitoring, limiting exposure or work duration, etc.
4. Providing appropriate protective equipment in conjunction with training, in its use maintenance.

In order to ensure that high standards of health and safety are maintained at all locations, the effectiveness of the arrangements is monitored through:

1. documented safety audits of each plant, instigated by the Health and Safety manager, with assistance from members of site management.

2. collection and analysis of accident statistics.

3. collection and analysis of employee sickness absence.

4. regular monitoring of personal exposures to hazardous substances and noise.

5. regular review of risk assessments.

### 3.1 Risk assessment – Structures & workplace environment

#### 3.1.1. Potential incident: Fire

<table>
<thead>
<tr>
<th>Personnel at particular risk:</th>
<th>All staff, visitors, or contractors in proximity to on-site buildings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Likelihood; consequences; and classification:</td>
<td>Unlikely; major; H</td>
</tr>
</tbody>
</table>

**Material and behavioural risk management**

- All staff to be trained in evacuation procedures (including the signal for evacuation, leaders to follow in the case of an evacuation, and a clearly designated gathering point), fire hazard identification, and fire suppression using standard equipment such as fire extinguishers.

- All staff to be aware of the division of responsibilities in the event of a fire.

- Smoking prohibited within five metres of all Yalelo buildings.

- Any problems experienced with vehicles to be reported to management at first possible instance.

- Standard potential fire hazards – such as overheating electrical equipment – are to be avoided.

- Occupied buildings to be situated a minimum of five
metres from all major electrical installations [batteries, generators, etc].

All electrical equipment to be up-to-date and stored in clearly designated clear spaces. All lighting to be electrical, i.e. no use of naked flames.

Flammable items to be stored away from ignition sources and oxidizing materials. Further, the storage area for flammables should be:

- remote from entry and exit points into buildings
- away from facility ventilation intakes or vents
- Have natural or passive floor and ceiling level ventilation and explosion venting
- use spark-proof fixtures
- be equipped with fire extinguishing devices and self-closing doors, and constructed of materials made to withstand flame impingement for a moderate period of time
- providing bonding and grounding of, and between, containers and additional mechanical floor level ventilation if materials are being, or could be, dispensed in the storage area
- where the flammable material is mainly comprised of dust, spark detection, and, if judged necessary, quenching systems are to be provided

Particular fire hazards to be clearly signposted.

### Protective equipment or other relevant material concerns:

| Fire extinguishers to be available in all buildings; all buildings to also be equipped with smoke detection and alarm systems. |
| Fire resistant, noise-absorbing materials should, to the extent feasible, be used for cladding on ceilings and walls. |

### Protective equipment maintenance/replacement interval:

| Extinguishers to be inspected on an annual basis. Electrical equipment to be checked on each instance of usage for loose wires, leaks, or other problems. |

3.1.2. Potential incident: Structural failure of buildings due to engineering shortfall,
A severe weather event, or other cause.

<table>
<thead>
<tr>
<th>Personnel at particular risk:</th>
<th>Personnel occupying buildings.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Likelihood; consequences; and classification:</td>
<td>Rare; catastrophic; H</td>
</tr>
<tr>
<td>Material and behavioural risk management</td>
<td>Surfaces, structures and installations should be easy to clean and maintain, and not allow for accumulation of hazardous compounds. Buildings should be structurally safe, provide appropriate protection against the climate, and have acceptable light and noise conditions. Heavy oscillating, rotating or alternating equipment should be located in dedicated buildings or structurally isolated sections. Work place structures should be designed and constructed to withstand the expected elements for the region and have an area designated for safe refuge, if appropriate. Standard Operating Procedures should be developed for project or process shut-down, including an evacuation plan, as per 3.1.1. Drills to practice the procedure and plan should also be undertaken annually. Passages to emergency exits should be unobstructed at all times. Exits should be clearly marked to be visible in darkness. The number and capacity of emergency exits should be sufficient for safe and orderly evacuation of the greatest number of people present at any time. Facilities also should be designed and built taking into account the needs of disabled persons.</td>
</tr>
<tr>
<td>Protective equipment or other relevant material concerns:</td>
<td>Clear signposts, lighting.</td>
</tr>
<tr>
<td>Protective equipment maintenance/replacement interval:</td>
<td>Replace as needed.</td>
</tr>
</tbody>
</table>
### 3.1.3. Potential incident: Contact with electric fence

<table>
<thead>
<tr>
<th>Personnel at risk:</th>
<th>All staff, contractors, visitors on-site in Siavonga</th>
</tr>
</thead>
<tbody>
<tr>
<td>Likelihood; consequences; and classification:</td>
<td>Likely; minor; M</td>
</tr>
<tr>
<td>Material and behavioural risk management</td>
<td>Except where absolutely necessary, staff to maintain reasonable distance from fence at all times. Where contact with fence is necessary, power supply to be deactivated and one staff member to remain maintaining power supply off until necessary contact with fence is complete. Where there is any doubt about the status of the fence, fence to be touched only while wearing protective gloves. Where contact with the fence is being made with bare hands, contact should initially be made with the back of the hand [not the palm] so as not prevent accidental seizure of the fence in the case of electric shock.</td>
</tr>
<tr>
<td>Protective equipment or other relevant material concerns:</td>
<td>Safety gloves.</td>
</tr>
<tr>
<td>Protective equipment maintenance/replacement interval:</td>
<td>Replace as needed.</td>
</tr>
</tbody>
</table>
### 3.1.4. Potential incident: Falls, slips, stumbles

<table>
<thead>
<tr>
<th>Personnel at risk:</th>
<th>All staff, visitors, contractors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Likelihood; consequences; and classification:</td>
<td>Likely; moderate; H</td>
</tr>
<tr>
<td>Material and behavioural risk management</td>
<td>Accidental slippages are the most common workplace accident, and thus worthy of particular attention.</td>
</tr>
<tr>
<td></td>
<td>In all instances, staff should wear non-slip shoes and tidy outfits, i.e. no dangling fabric, shoelaces or other material.</td>
</tr>
<tr>
<td></td>
<td>Workplace spaces should be kept free of any obstacles.</td>
</tr>
<tr>
<td></td>
<td>Walkways should be clearly marked, level where possible, smooth, and non-slippery. Spillages – of water, oil, or other material – should be cleaned up immediately; where any residue remains, it should be marked with signs until cleanup is complete.</td>
</tr>
<tr>
<td></td>
<td>Lighting is to be of sufficient quality to ensure that any environment where staff are expected to work has decent visibility.</td>
</tr>
<tr>
<td>Protective equipment or other relevant material concerns:</td>
<td>Cleaning equipment, storage facilities, and appropriate footwear and gloves to be available at all times. Inappropriately dressed staff to be prohibited from working.</td>
</tr>
<tr>
<td>Protective equipment maintenance/replacement interval:</td>
<td>Replace as needed.</td>
</tr>
</tbody>
</table>
### 3.1.5. Potential incident: Consumption of unhygienic food resulting in illness

| Personnel at particular risk: | All staff consuming food prepared within the on-site canteen |
| Likelihood; consequences; and classification: | Moderate; moderate; H |

### Material and behavioural risk management

Yalelo cannot reasonably guarantee the safety of all food consumed on-site, nor the safety of food prepared with the Yalelo canteen if it is subsequently eaten off-site. However, food served on-site by Yalelo employees for the benefit of Yalelo staff must be of a standard to minimize the chance of illness, such that illness should only occur in difficult-to-avoid circumstances (such as when a previously reliable food source has been undetectably contaminated). In aid of this:

- All food to be cooked for a sufficient time so as to eliminate expected microorganisms.
- All water to be either obtained from a reputable source or boiled a minimum of five minutes before being served for drinking.
- Food preparation and serving spaces to be kept free of grease, stains, or other material – particularly if staff are leaving the space unattended and thus providing an opportunity for infestation by rodents, cockroaches, and other vermin - as well as being neatly and tidily organized.
- Food storage areas to be dry, cool, and designed so as to be difficult for vermin to access (i.e. packets of flour should be kept within closed cupboards or sealed jars, not left on counters unattended).
- On any sign of infestation, steps must be taken to eliminate it, and if there is any suggestion of contamination of food, or if food is suspected of rotting, going off, or exceeding its “use-by date”, that food is to be disposed of.
- Staff to always wash hands before eating food. This is
compulsory for all staff, but note that it is particularly an issue for staff who have been in contact with animals.

<table>
<thead>
<tr>
<th>Protective equipment or other relevant material concerns:</th>
<th>Plastic gloves, cleaning equipment (degreaser, soap, disinfectant, anti-bacterial handwash) to be available in the canteen, in proximity to eating areas, and anywhere else where food might be served or is permitted to be eaten.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Protective equipment maintenance/replacement interval:</td>
<td>Equipment to be replaced whenever needed.</td>
</tr>
</tbody>
</table>

### 3.1.6. Potential incident: Encounters with site intruders

<table>
<thead>
<tr>
<th>Personnel at particular risk:</th>
<th>All staff, visitors, and contractors on-site, though naturally individuals on-site after hours or when the site is relatively unattended are at greater risk.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Likelihood; consequences; and classification:</td>
<td>Unlikely; moderate; M</td>
</tr>
<tr>
<td>Material and behavioural risk management</td>
<td>Yalelo employs a range of security measures designed to deter unauthorized entry, including the presence of a security fence, armed guards, guard dogs, security cameras, alarms, and perimeter lights. In the event that non-security staff encounter or observe an unauthorized intruder, the intruder should not be confronted directly, but security staff (who should be in close proximity) alerted. Note also that staff should employ standard measures concerning their personal security when approaching and leaving the site: for instance, travelling in groups during night-time. The appropriate measures for security staff to take in the event of an intruder are identified elsewhere.</td>
</tr>
<tr>
<td>Protective equipment or other relevant material concerns:</td>
<td>NA</td>
</tr>
<tr>
<td>Protective equipment maintenance/replacement interval:</td>
<td>NA</td>
</tr>
</tbody>
</table>
### 3.1.7. Potential incident: Exposure to water-born disease [e.g. malaria]

| Personnel at particular risk: | All individuals on-site in Siavonga |
| Likelihood; consequences; and classification: | Moderate; moderate; H |
| Material and behavioural risk management | Malaria and other diseases are a constant risk in Zambia, but staff electing to work at Yalelo’s Siavonga site may take on an additional level of exposure. Staff should minimize exposure to stagnant water in the site area; stagnant ponds on Yalelo’s property are to be drained or otherwise eliminated. In the medium-term, Yalelo may to set-up an on-site clinic. This would be used by staff for screening on the development of any symptoms. |
| Protective equipment or other relevant material concerns: | Drainage pumps and hoses, medical supplies. |
| Protective equipment maintenance/replacement interval: | Replace / maintain as needed. |

### 3.2 Risk assessment – Risks encountered as part of work duties

#### 3.2.1. Potential incident: Muscle strain or injury caused as a result of heavy lifting or repetitive physical tasks

| Personnel at particular risk: | All personnel whose duties involve physical labour |
| Likelihood; consequences; and classification: | Likely; minor; M |
| Material and behavioural risk management | Given the nature of Yalelo’s business, manual lifting, among other tasks, is likely to feature frequently in staff duties, especially concerning the transport of fish feed, fish, ice, and water. To minimize injury: Staff should not attempt to manually shift a load of 25kg or over individually. In a group of staff attempting to shift a load, the total mass of the object being moved divided by the number of participants shifting the load should not exceed 25kg. |
Wherever possible, duties among staff should be alternated so that no individual staff member is conducting continuous heavy lifting without recovery breaks.

On experiencing any notable pain, staff should stop immediately and rest until the severity of the injury can be determined.

Wherever necessary, lifting should be assisted by mechanical devices – e.g. wheelbarrows – or powered machinery, such as cranes, forklifts, or pick-up trucks. Management is to ensure that such equipment is available as appropriate.

<table>
<thead>
<tr>
<th>Protective equipment or other relevant material concerns:</th>
<th>Gloves to be available for repeated lifting or manipulating potentially abrasive objects.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>As noted above, mechanical and powered devices to be available as needed.</td>
</tr>
<tr>
<td>Protective equipment maintenance/replacement interval:</td>
<td>All equipment to be maintained, replaced if necessary. The absence of appropriate</td>
</tr>
<tr>
<td></td>
<td>equipment is insufficient reason for staff to be asked to violate the guidelines</td>
</tr>
<tr>
<td></td>
<td>above.</td>
</tr>
</tbody>
</table>

### 3.2.2. Potential incident: Attacked by animal, e.g. hippopotamus, crocodile, snake, or other on-site animals (including potentially goats or guards dogs)

<table>
<thead>
<tr>
<th>Personnel at particular risk:</th>
<th>All on-site staff</th>
</tr>
</thead>
<tbody>
<tr>
<td>Likelihood; consequences; and classification:</td>
<td>Unlikely; major; H</td>
</tr>
<tr>
<td>Material and behavioural risk management</td>
<td>This risk is more pronounced for Siavonga-based operations, where Lake Kariba is known to harbor both crocodiles and hippopotamuses, and snakes are more likely to be encountered in the surrounding area.</td>
</tr>
</tbody>
</table>

Staff should exercise caution when animals may be in close proximity but undetected, such as when entering areas of dense bush or long grass.

Covering footwear should be worn at all times.

On sighting a potentially dangerous animal, if it is in an unaggressive state staff should immediately remove
themselves from its vicinity.

Some specific animals may cause problems: for instance, improperly disposed waste from the site may attract rodents which in turn could attract snakes, or for other reasons crocodiles or hippos could become habituated to residing in the vicinity of the site. In such instances, specific management attention, and potentially the hiring of outside experts, may be required.

In the event of snake-bite, immediate first-aid and subsequent transfer to a hospital must be sought in all instances, regardless of whether the snake in question is suspected of being non-venomous or the severity of the bite.

<table>
<thead>
<tr>
<th>Protective equipment or other relevant material concerns:</th>
<th>Bandages, first aid equipment to be available.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Protective equipment maintenance/replacement interval:</td>
<td>Replace as needed.</td>
</tr>
</tbody>
</table>

3.2.3. Potential incident: Transport-related accident: cars, trucks, tractors, and other land vehicles

| Personnel at particular risk: | All staff, visitors, and contractors, all of whom can be expected to drive, ride as passengers in, or potentially be in proximity to vehicles as part of their association with Yalelo |
| Likelihood; consequences; and classification: | Unlikely; major; H |
| Material and behavioural risk management | Staff will frequently be required to employ road vehicles during activities, varying from business trips, movement between sites, transporting equipment, supplies and product, or hauling loads on-site. Note that some stretches of road – especially those passing through villages, commonly shared with large vehicles, or in winding low-visibility terrain, may be particularly dangerous. |
As should go without saying, in all instances staff are required to possess all relevant licenses and training, and to obey all applicable road rules. Further, staff should be courteous and deferential with regards to other vehicles on the road. Seatbelts must be worn at all times, and the number of passengers in a vehicle is not to exceed the number of available seatbelts.

While driving in proximity to pedestrians, staff must ensure awareness of their vehicle, including using the horn for that purpose if appropriate.

Clear traffic rules are to be designated on Yalelo property, denoted by proper signage, and clear rules for the operation of different vehicles [for example, how to configure TLBs while in transport]. Delivery and private vehicles are to be restricted to particular on-site areas.

<table>
<thead>
<tr>
<th>Protective equipment or other relevant material concerns:</th>
<th>All vehicles to be kept up to date, and not driven given any failure in a safety-related system;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Protective equipment maintenance/replacement interval:</td>
<td>All vehicles to be regularly maintained and kept in a roadworthy condition, subject to inspection both annually, following any incident, or on any suspicion of mechanical problems.</td>
</tr>
</tbody>
</table>
### 3.2.4 Potential incident: Transport-related accident: watercraft

<table>
<thead>
<tr>
<th>Personnel at particular risk:</th>
<th>Staff whose duties involve regular journeys between fish cages and shore, e.g. fish feeding, fish harvesting</th>
</tr>
</thead>
<tbody>
<tr>
<td>Likelihood; consequences; and classification:</td>
<td>Unlikely; major; H</td>
</tr>
<tr>
<td>Material and behavioural risk management</td>
<td>Watercraft to be piloted only be licensed and experienced individuals.</td>
</tr>
</tbody>
</table>

   Watercraft to not be piloted if they are insufficient to cope with water and weather conditions. Should this interfere with scheduled fish feeding, alternative craft must be sourced. Watercraft employed by Yalelo to be of sufficient quality and capacity that it is possible to evacuate all staff from the lake in a short amount of time in the event of inclement weather conditions.

   All individuals to be equipped with lifejackets prior to entering the water and to be worn at all times while on the water.

   Where necessary – such as when engaging in feeding or construction operations that may increase the risk of falls – staff are to be provided with harnesses with safety clips / karabiners to lock onto lines or fixed points.

   While on watercraft, all individuals are to follow all reasonable directions of the craft's pilot, and to employ standard safe behavior (i.e. not standing up in a moving craft).

   All staff making use of watercraft must have sufficient swimming ability to be confident by themselves in deep water. Any staff with concerns are to express them immediately so that they may be assigned to other duties.

   All water-based staff to be given a safety course prior to commencing activities.

   Vessels and mooring points must be designed so that secure and stable berthing is possible, to reduce the
<table>
<thead>
<tr>
<th>Risk of staff falling or being trapped between the vessel and the mooring point.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Protective equipment or other relevant material concerns:</strong></td>
</tr>
<tr>
<td>All vehicles to be kept up to date, and not driven given any failure in a safety-related system.</td>
</tr>
<tr>
<td>Fire extinguishers on board all boats.</td>
</tr>
<tr>
<td>Life-jackets for all personnel on water.</td>
</tr>
<tr>
<td>Signage by dock area: “NO LIFE-JACKET = NO JOB”</td>
</tr>
<tr>
<td><strong>Protective equipment maintenance/replacement interval:</strong></td>
</tr>
<tr>
<td>All vehicles to be regularly maintained and kept in a roadworthy condition, and subject to inspection annually, following any incident, or on any suspicion of mechanical problems.</td>
</tr>
</tbody>
</table>

### 3.2.5. Potential incident: Boat crash at night

<table>
<thead>
<tr>
<th>Personnel at particular risk:</th>
<th>Other lake users and Yalelo lake-based staff</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Likelihood; consequences; and classification:</strong></td>
<td>Unlikely; moderate; M</td>
</tr>
<tr>
<td><strong>Material and behavioral risk management</strong></td>
<td>Kapenta rigs frequently navigate at night, as do other lake users. As a result there is a risk of collision between boats or boats and floating Yalelo cages.</td>
</tr>
<tr>
<td></td>
<td>To minimize this risk, all cages and boats will be fitted with adequate lights (solar and battery) and reflective markings.</td>
</tr>
<tr>
<td><strong>Protective equipment or other relevant material concerns:</strong></td>
<td>Lights, reflective tape</td>
</tr>
<tr>
<td><strong>Protective equipment maintenance/replacement interval:</strong></td>
<td>Replaced as needed. Check light batteries weekly.</td>
</tr>
</tbody>
</table>

### 3.2.5. Potential incident: Boat engines tangle with mooring ropes

<table>
<thead>
<tr>
<th>Personnel at particular risk:</th>
<th>Other lake users and Yalelo lake-based staff</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Likelihood; consequences; and classification:</strong></td>
<td>Moderately likely; low impact; M</td>
</tr>
<tr>
<td><strong>Material and behavioral risk management</strong></td>
<td>Boats may not see Yalelo mooring ropes unless they are marked. This could result in boat engines becoming tangled in the ropes, causing damage to</td>
</tr>
</tbody>
</table>
As a result, high visibility reflectors will be attached at one meter intervals to make other lake users aware of their location.

<table>
<thead>
<tr>
<th>Protective equipment or other relevant material concerns:</th>
<th>High visibility reflectors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Protective equipment maintenance/replacement interval:</td>
<td>Replaced as needed. Inspect once per month for damaged or missing reflectors.</td>
</tr>
</tbody>
</table>

### 3.2.5. Potential incident: Hearing damage from excessive noise

<table>
<thead>
<tr>
<th>Personnel at particular risk:</th>
<th>Staff working in close proximity to machinery, including potentially construction equipment, powered saws, or vehicles.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Likelihood; consequences; and classification:</td>
<td>Unlikely; moderate; M</td>
</tr>
</tbody>
</table>
| Material and behavioural risk management | Yalelo’s operations are unlikely to involve prolonged exposure of staff to loud noises. As guidelines, however:

No employee should be exposed to a noise level greater than 85 dB(A) for a duration of more than 8 hours per day without hearing protection. In addition, no unprotected ear should be exposed to a peak sound pressure level (instantaneous) of more than 140 dB(C).

The use of hearing protection should be enforced actively when the equivalent sound level over 8 hours reaches 85 dB(A), the peak sound levels reach 140 dB(C), or the average maximum sound level reaches 110 dB(A). Hearing protective devices provided should be capable of reducing sound levels at the ear to at least 85 dB(A).

Although hearing protection is preferred for any period of noise exposure in excess of 85 dB(A), an equivalent level of protection can be obtained, but less
easily managed, by limiting the duration of noise exposure. For every 3 dB(A) increase in sound levels, the ‘allowed’ exposure period or duration should be reduced by 50 percent.

Prior to the issuance of hearing protective devices as the final control mechanism, use of acoustic insulating materials, isolation of the noise source, and other engineering controls should be investigated and implemented, where feasible.

Hearing protection is also to be available if requested by staff at all times.

<table>
<thead>
<tr>
<th>Protective equipment or other relevant material concerns:</th>
<th>Ear protection.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Protective equipment maintenance/replacement interval:</td>
<td>Replaced as needed.</td>
</tr>
</tbody>
</table>

**3.2.6. Potential incident: Exposure to extreme temperatures**

<table>
<thead>
<tr>
<th>Personnel at particular risk:</th>
<th>Staff working on-site in Siavonga or in association with cold storage rooms</th>
</tr>
</thead>
<tbody>
<tr>
<td>Likelihood; consequences; and classification:</td>
<td>Moderate; moderate; H</td>
</tr>
<tr>
<td>Material and behavioural risk management</td>
<td>Both Lusaka and Siavonga, but particularly Siavonga, are subject to unusually high temperatures, especially around the month of October. Staff who work outside or in the absence of air conditioning during such times are at risk of dehydration and heat stroke. To minimize this risk:</td>
</tr>
<tr>
<td></td>
<td>Weather forecasts are to be monitored in advance.</td>
</tr>
<tr>
<td></td>
<td>Work activities should be structured in recognition of the weather (for instance, avoiding physical activity during the hottest times of the day).</td>
</tr>
<tr>
<td></td>
<td>Fresh, potable water must always be within easy reach of staff; hoses should also be accessible.</td>
</tr>
</tbody>
</table>
Shaded resting spaces – such as under a tree, roof, canopy, or cabin – are also to be available to staff.

Upon any symptoms of thirst, dizziness, blurred vision, or related symptoms, staff are to cease work immediately, rest, and seek medical attention if the situation does not improve.

Staff may also experience problems using the cold storage facility. Should unusual coldness be felt while stocking or destocking the facility, staff should remain outside until they feel they have sufficiently rewarmed. If the prevailing weather is too cool to effectively rewarm, staff should retire to one of the on-site buildings or vehicles.

Note cold facilities are to be designed to be easily openable from the inside.

<table>
<thead>
<tr>
<th>Protective equipment or other relevant material concerns:</th>
<th>Water to be constantly in supply / stocked if necessary at all Yalelo sties.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Protective equipment maintenance/replacement interval:</td>
<td>Replaced as needed.</td>
</tr>
</tbody>
</table>

### 3.2.7. Potential incident: Falls from height

<table>
<thead>
<tr>
<th>Personnel at particular risk:</th>
<th>Staff involved in construction or maintenance activities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Likelihood; consequences; and classification:</td>
<td>Unlikely; moderate; M</td>
</tr>
<tr>
<td>Material and behavioural risk management</td>
<td>Given the nature of the terrain Yalelo has based its activities on, and the low profile of most of its buildings, it is judged unlikely that most staff are likely to experience falls from height, or that the distances fallen would be likely to be especially high, at least compared to what might be found in other industries. Nevertheless, there may be occasions where the risk is present: for instance, in building or adjusting a water tower, recovering items from the roofs of containers, or attempting to hang or suspend items from trees. In such instances:</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>---</td>
<td>---</td>
</tr>
</tbody>
</table>
Ladders or other climbing gear (such as cherrypickers) must be used in preference to simply scaling naturally occurring features.

Any such equipment must be checked for stability, i.e. placed on solid, level ground, held manually, etc.

Staff must not act alone but in groups of at least two, with one acting as an observer.

Hard hats and other protective safety gear must be worn.

<table>
<thead>
<tr>
<th>Protective equipment or other relevant material concerns:</th>
<th>Protective safety gear as indicated above; ladders, railings, guards, and other devices.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Protective equipment maintenance/replacement interval:</td>
<td>Replaced as needed.</td>
</tr>
</tbody>
</table>

### 3.2.8. Potential incident: Accidents causing physical injury resulting from use of powered or non-powered tools and equipment

<table>
<thead>
<tr>
<th>Personnel at particular risk:</th>
<th>Staff who use such equipment as part of their duties</th>
</tr>
</thead>
<tbody>
<tr>
<td>Likelihood; consequences; and classification:</td>
<td>Moderate; moderate; H</td>
</tr>
</tbody>
</table>

**Material and behavioural risk management**

Several different varieties of powered equipment will be used in Yalelo’s activities. In additions to cuts, burns or crushing injuries caused by using, for instance, saws, hammers, welding equipment, or jackhammers, the close proximity of the Siavonga site to Lake Kariba, and the possibility of frequent heavy rain, greatly increases the chance of electrocution.

Equipment is to be used strictly for its intended purpose and in its intended manner.

Equipment to be used only in a supervised or easily visible environment.

Where relevant – such as on generators or large cutting tools – equipment must have an emergency stop button.
<table>
<thead>
<tr>
<th>Where a machine or equipment has an exposed moving part or exposed pinch point that may endanger the safety of any worker, the machine or equipment should be equipped with, and protected by, a guard or other device that prevents access to the moving part or pinch point.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Machinery with exposed or guarded moving parts, or in which energy can be stored (e.g. compressed air, electrical components), is to be turned off, disconnected, isolated, and de-energised during servicing or maintenance.</td>
</tr>
<tr>
<td>Only trained staff members are permitted to use equipment; untrained staff members must be trained by a competent individual to a point where both they are and the trainer feel confident in their abilities.</td>
</tr>
<tr>
<td>All standard safety gear – such as eye protection while welding; boots; gloves - to be worn, and to be of a suitably high standard.</td>
</tr>
<tr>
<td>All electrical installations to be waterproofed.</td>
</tr>
<tr>
<td>Electrical circuits to be grounded and controlled through a fuse box.</td>
</tr>
<tr>
<td>All cables to be of high standard, not in contact with each other, and waterproof.</td>
</tr>
<tr>
<td>Training in the correct handling of electrical equipment to be provided where necessary.</td>
</tr>
<tr>
<td>Proper eye protection such as welder goggles and/or a full-face eye shield is to be provided for all personnel involved in welding operations. Welding barrier screens (a solid piece of light metal, canvas, or plywood designed to block welding light) around the work station, as well as devices to extract fumes, may also be required.</td>
</tr>
<tr>
<td>Special hot work and fire prevention precautions</td>
</tr>
<tr>
<td>should be implemented if welding or hot cutting is undertaken outside established welding work stations. Special procedures are also required for hot work on tanks or vessels that have contained flammable materials.</td>
</tr>
</tbody>
</table>

| Protective equipment or other relevant material concerns: | Safety gear & signage as indicated above. |

| Protective equipment maintenance/replacement interval: | Replaced as needed. |

### 3.2.9. Potential incident: Inhalation of toxic vapours or dust

| Personnel at particular risk: | Sivaonga site staff |
| Likelihood; consequences; and classification: | Unlikely; minor; M |
| Material and behavioural risk management | Certain materials – such as petrol – or activities – such as welding – may generate fumes that are toxic if inhaled in quantity. To minimize the risk of this: |

- Excessive quantities of volatile materials should not be stored on Yalelo sites.

- Where volatile materials are needed on site [such as, for instance, petrol or diesel], they should be stored in sealed containers in well-ventilated areas. Unrelated work should not be carried out in areas where volatile materials are present.

- Wherever possible, welding should be undertaken outside, or in large, well-ventilated spaces.

- Similarly, prolonged exposure to even non-toxic dust may cause lung irritation or other difficulties. Given well-ventilated workspaces, the option of working outside, and that none of Yalelo’s business sites are in naturally dusty locations, this is not considered to be a considerable risk; nevertheless, the guidelines above for vola |

| Protective equipment or other relevant material | Ventilated storage areas; if considered necessary, electric fans to aid air circulation. |
3.2.10. Potential incident: Contact with toxic materials

| Personnel at particular risk: | Sivaonga site staff |
| Likelihood; consequences; and classification: | Unlikely; moderate; L |
| Material and behavioural risk management | Any stored toxic materials to be clearly marked as such; staff to be made aware of their presence. |
| | Work employing toxic materials to be well-supervised. |
| | Lavatory and washing facilities, and a designated space for changing clothes, to be provided. |
| Protective equipment or other relevant material concerns: | Gloves, goggles, and fully covering clothes and shoes to be worn by any staff working with toxic equipment, as well as facemasks or more extreme equipment if required. |
| Protective equipment maintenance/replacement interval: | Replaced as needed. |

3.2.11. Potential incident: Injury caused by explosive release of pressurized material or other mishap involving pressurized material

| Personnel at particular risk: | Staff at Siavonga site |
| Likelihood; consequences; and classification: | Unlikely; moderate; M |
| Material and behavioural risk management | Common examples of materials under pressure in Yalelo operations include liquids [using water pumps] or air [in cylinders for diving]; they may also be occasions where pressurized air or water hoses are used for cleanup or other purposes. |
| | At all times, staff should be aware of the dangers of working with such material, and never attempt work when there was ambiguity regarding the current state of pressurization. More specific safety procedures will
3.2.12. Potential incident: Development of resistance to antibiotic drugs

| Personnel at particular risk: | NA |
| Likelihood; consequences; and classification: | NA |
| Material and behavioural risk management | Yalelo does not currently plan to include antibiotic drugs in its fish feed, and therefore the safety risk in this area is minimal. Should the company policy in this area change, this section will require review. |
| Protective equipment or other relevant material concerns: | NA |
| Protective equipment maintenance/replacement interval: | NA |

3.2.13. Potential incident: SCUBA-related injury or incident potentially occasioning death

| Personnel at particular risk: | Yalelo-employed divers |
| Likelihood; consequences; and classification: | Unlikely; major; H |
| Material and behavioural risk management | SCUBA diving plays a key role in Yalelo's operations, particularly with regards to installation and maintenance of fish cages. This is a naturally highly risky activity, with Lake Kariba presenting its own set of challenges even for experienced SCUBA divers. Divers contracted with Yalelo will be fully qualified and follow their own comprehensive scuba diving safety manual. Key points include: |
Divers further commit to diving only in calm, predictable weather conditions.

To take extra precautions in recognition of the potential for proximity to dangerous wildlife.

To dive only when approved by management, with a clearly stated purpose for the dive.

To maximize available supervision while diving.

To take responsibility for ensuring that all equipment is well-maintained, functional, and, where appropriate [i.e. air cylinders] formally inspected at least annually.

To use a modern, sophisticated dive computer while diving, rather than relying on approximate measurements.

<table>
<thead>
<tr>
<th>Protective equipment or other relevant material concerns:</th>
<th>Up-to-date and fully functioning dive equipment.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Protective equipment maintenance/replacement interval:</td>
<td>As per standard diving safety standards or as needed, whichever is sooner.</td>
</tr>
</tbody>
</table>

**3.2.14. Potential incident: Problems concerning the general safety of the site not specified previously, including ensuring the site is safely navigable for visiting non-Yalelo employees**

<table>
<thead>
<tr>
<th>Personnel at particular risk:</th>
<th>All personnel.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Likelihood; consequences; and classification:</td>
<td>Moderate; moderate; H</td>
</tr>
<tr>
<td>Material and behavioural risk management</td>
<td>First aid kits are to be contained</td>
</tr>
</tbody>
</table>

Workplaces should, as far as feasible, receive natural light and be supplemented with sufficient artificial illumination to promote workers’ safety and health, and enable safe equipment operation. Supplemental ‘task lighting’ may be required where specific visual acuity requirements should be met.

Emergency lighting of adequate intensity should be
installed and automatically activated upon failure of the principal artificial light source to ensure safe shutdown, evacuation, etc.

Passageways for pedestrians and vehicles within and outside buildings should be segregated and provide for easy, safe, and appropriate access.

Equipment and installations requiring servicing, inspection, and/or cleaning should have unobstructed, unrestricted, and ready access.

Hand, knee and foot railings should be installed on stairs, fixed ladders, platforms, permanent and interim floor openings, loading bays, ramps, etc.

Openings should be sealed by gates or removable chains.

Covers should, if feasible, be installed to protect against falling items.

Measures to prevent unauthorized access to dangerous areas should be in place.

Appropriately equipped first-aid stations are to be easily accessible throughout all work sites.

Eye-wash stations are to be provided close to all workstations where immediate flushing with water is the recommended first-aid response.

Emergency procedures are to be in place for dealing with cases of trauma or serious illness up to the point at which patient care can be transferred to an appropriate medical facility.

The person receiving a visitor is responsible for ensuring their safety whilst on Yalelo premises. Visitors at the Siavonga site are to sign in at the gate.

The necessary personal protective equipment is to be
obtained by the host and worn by the visitor.

The person receiving a visitor should advise them of any specific risks to which they may be exposed whilst on site and the emergency arrangements, including the location of the evacuation assembly point. A reasonable level of supervision should be provided for each visitor in order to prevent them from straying into hazardous areas and being exposed to danger.

On arrival at site, contract drivers or drivers making a collection must first report to the security gate where they will be given instructions for loading etc. The security personnel will also ensure that drivers are aware of the site rules, and the procedure to follow in the event of an emergency.

<table>
<thead>
<tr>
<th>Protective equipment or other relevant material concerns:</th>
<th>First aid kits; high visibility clothing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Protective equipment maintenance/replacement interval:</td>
<td>Replaced as needed.</td>
</tr>
</tbody>
</table>

### 6. Contractors

Yalelo will only use contractors who are committed to fulfilling their role while following safety standards equal to or higher than Yalelo’s own. In this regard, contractors shall always be subject to a reasonable degree of supervision by Yalelo representatives. All employees are encouraged to play their part in this approach by reporting unsafe working practices to management. Elements of supervision include checks of contractor competence, insurance documentation, quality of risk assessments and safe working procedures prior to work commencing. The work of contractors is monitored through routine inspection to ensure, as far as reasonably practicable, that these safe working procedures are being followed. In the supervision of contractors, Yalelo requires that its employees demonstrate a level of commitment to achieving high standards of health and safety which is consistent with the quality, output and timeliness demands that are placed on the contractor.

Nevertheless, Yalelo cannot take direct responsibility for the behavior of contractors; in all instances the primary responsibility to supervise the contractor’s work and workforce rests with the contractor. Provision of adequate supervision will therefore be a major element in contractor assessment. Yalelo will not tolerate unsafe working
practices; in all contracts entered into by Yalelo, failure to maintain the appropriate standards shall be automatically taken as a breach of contract.

STAFF STATEMENT

I confirm that I understand the material contained in this document and, as per my standing commitment to following Yalelo Limited’s rules and regulations, agree to abide by it.

Name: _______________________________________________________

Signed: _______________________________________________________

Witness (name): _______________________________________________

Witness (signed): _______________________________________________

Date: _____________
Appendix 7: Consultative Meeting on Relocation of Children’s Cemetery and PAP

Register of Participants of a Consultative Meeting held at Kamimbi Fishing Camp on 12th May, 2012

1. Mr. Bornwell Koonde  Farmer and Village headman for Namachembele (Chairman)
2. Choolwe Mudenda  Consultant – EIA - Facilitator
3. Fisho P. Mwale  CEO Yalelo Ltd – in attendance
4. Mebelo Wamulume  Fisheries Officer – Observer
5. S. A, Nyirenda  Fisheries Camp Officer
6. Tyson Siluuni  Fisher
7. Webster Matiya  Fisher
8. Abby Simungulu  Fisher
9. Tyson Tembo  Fisher
10. Peter Namilomba  Fisher
11. Assizzio Simungulu  Fisher
12. Antigoes Simungulu  Fisher
13. Kelvin Kamunika  Fisher
14. Gift Moonga  Fisher
15. Charles Halubanje  Farmer
16. Amos Gasa  Fisher
17. Anderson Sinakayaba  Fisher
18. Victor Matiya  Farmer
19. Gerald Makasa  Fisher
20. Mrs Makasa  Fisher
22. Joseph Hambulo  Fisher
23. Fanny Hamajata  Farmer
24. Richard Simungulu  Fisher
25. Morris Chikonde  Fisher
26. Mrs Webster Matiya  Fisher
27. Mrs Lloyd, S  Fisher
28. Mrs Charles S.,  Fisher
29. Mrs Lontiya Muleya  Farmer
30. Mrs Chibale
31. Jaster Matiya  Fisher
A. Register of Participants of a Consultative Meeting held at Kamimbi Fishing Camp on 12th May, 2012

<table>
<thead>
<tr>
<th>No.</th>
<th>Name</th>
<th>Occupation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Mr. Bornwell Koonde</td>
<td>Farmer and Village headman for Namachembele (Chairman)</td>
</tr>
<tr>
<td>2</td>
<td>Chooheve Mudenda</td>
<td>Consultant – EIA - Facilitator</td>
</tr>
<tr>
<td>3</td>
<td>Fishe P. Mwale</td>
<td>CEO Yagelo Ltd</td>
</tr>
<tr>
<td>4</td>
<td>Mbelo Wamulume</td>
<td>Fisheries Officer – Observer</td>
</tr>
<tr>
<td>5</td>
<td>S. A. Nyirenda</td>
<td>Fisheries Camp Officer</td>
</tr>
<tr>
<td>6</td>
<td>Tyson Slinuni</td>
<td>Fisher</td>
</tr>
<tr>
<td>7</td>
<td>Webster Matiya</td>
<td>Fisher</td>
</tr>
<tr>
<td>8</td>
<td>Abby Simungulu</td>
<td>Fisher</td>
</tr>
<tr>
<td>9</td>
<td>Dyson Tembo</td>
<td>Fisher</td>
</tr>
<tr>
<td>10</td>
<td>Peter Namilomba</td>
<td>Fisher</td>
</tr>
<tr>
<td>11</td>
<td>Assizio Simungulu</td>
<td>Fisher</td>
</tr>
<tr>
<td>12</td>
<td>Antigoes Simungulu</td>
<td>Fisher</td>
</tr>
<tr>
<td>13</td>
<td>Kelvin Kamunika</td>
<td>Fisher</td>
</tr>
<tr>
<td>14</td>
<td>Gift Moonga</td>
<td>Fisher</td>
</tr>
<tr>
<td>15</td>
<td>Charles Halubanjie</td>
<td>Farmer</td>
</tr>
<tr>
<td>16</td>
<td>Armos Gasa</td>
<td>Fisherman</td>
</tr>
<tr>
<td>17</td>
<td>Anderson Sinakayaba</td>
<td>Fisher</td>
</tr>
<tr>
<td>18</td>
<td>Victor Matiya</td>
<td>Fisher</td>
</tr>
<tr>
<td>19</td>
<td>Gerald Bakasa</td>
<td>Farmer</td>
</tr>
<tr>
<td>20</td>
<td>Mrs. Makasa</td>
<td>Fisher</td>
</tr>
<tr>
<td>21</td>
<td>Bernard Namilembo</td>
<td>Fisher</td>
</tr>
<tr>
<td>22</td>
<td>Joseph Hambulo</td>
<td>Farmer</td>
</tr>
<tr>
<td>23</td>
<td>Fanny Hamajata</td>
<td>Fisher</td>
</tr>
<tr>
<td>24</td>
<td>Richard Simungulu</td>
<td>Fisher</td>
</tr>
<tr>
<td>25</td>
<td>Morris Chikonde</td>
<td>Fisher</td>
</tr>
<tr>
<td>26</td>
<td>Mrs Webster Matiya</td>
<td>Fisher</td>
</tr>
<tr>
<td>27</td>
<td>Mrs. Lloyd, Stobamende</td>
<td>Fisher</td>
</tr>
<tr>
<td>28</td>
<td>Mrs Charles S.</td>
<td>Fisher</td>
</tr>
<tr>
<td>29</td>
<td>Mrs Lontya Muleya</td>
<td>Fisher</td>
</tr>
<tr>
<td>30</td>
<td>Mrs Chibale</td>
<td>Fisher</td>
</tr>
<tr>
<td>31</td>
<td>Jaster Matiya</td>
<td>Fisherman</td>
</tr>
</tbody>
</table>

B. Record of Meeting

The meeting was called to order by the Headman at 11:10 hours. The Chairman, Mr. Bornwell Koonde, Village Head of Namachembele and Kamimbi Fishing Camp, welcomed all the participants and guests Mr. Fishe Mwale.
B. Record of Meeting

The meeting was called to order by the Headman at 11:10 hours. The Chairman, Mr. Bornwell Koonde, Village Head of Namachembele and Kamimbi Fishing Camp welcomed all the participants and guests Mr. Fisho Mwale, Yalelo CEO, Mr. Choolwe Mudenda, Consultant and Mr. Mebelo Wamulume, Fisheries Officer. The Chair urged the meeting to be free and orderly. Each person should raise their hand for their turn to speak.

Mr. Koonde further explained that the purpose of the meeting was to discuss the social and environmental issues raised by Yalelo’s fish farming activities in the neighbouring area. Mr. Koonde invited the Consultant to introduce the Meeting Agenda.

The Consultant itemised the issues that had arisen from previous discussions and requested that all residents suggest alternatives if desired.

Agenda

1. Lakeshore Gardening Activities
   a. A discussion about the seasonal lakeshore gardening activities by local residents on the 100m of communal land in front of Yalelo’s plot. Suggested discussion points: 1) health and safety, 2) increased traffic, 3) how to best enable all Lake Users to freely use and benefit from the land.

2. Fencing and Enclosures:
   a. A discussion to canvass opinions of the best fencing policy for all stakeholders. Suggested discussion points: 1) trade-off between free access within Yalelo’s land vs community safety, 2) how to ensure free livestock movements by the small game which occasional walk through the plot

3. Children’s Cemetery:
   a. A discussion regarding the anthill on Yalelo’s plot which used for entombment of pre-mature babies and stillbirths. Suggested discussion points: 1) resident’s own plans for the site, 2) how best to protect and respect the site.

4. Squatters
   a. A discussion regarding the squatters on Yalelo’s plot. Suggested discussion points: 1) verify names and details of squatters 2) ensure Yalelo has not missed identifying any squatters, 3) discussion of options for squatters.

Yalelo CEO Mwale proceeded to outline the company’s suggestions regarding the items listed on the agenda. In doing so, he prefaced his submission with company policy to live in harmony with neighbours and to minimise disruption to previous livelihoods notwithstanding the anticipated positive impacts of the planned investments.

Mr. Mwale’s suggestions were:
1. Lakeshore Gardening Activities
   
a. Yalelo does not want to cause disruption to people’s livelihoods, including disrupting their use of the lakeshore area. He reminded the meeting participants that the first 100 metres of any waterfront land is public and that all local residents have a right to freely use it. Correspondingly, Yalelo would ensure no effort was made to block access or activities on the land. However, Mr. Mwale did suggest that both Yalelo and local residents put forward ideas to ensure the safety of all lake-shore users, given Yalelo would be using the land to bring feed to boats and harvested fish onshore.

2. Fencing:
   
a. Mr. Mwale suggested that the majority of Yalelo’s plot should not be fenced. This would allow local residents to use paths and local livestock to graze. In the interest of health, safety and security, Mr. Mwale suggested that key areas such as busy yards and valuable machinery be fenced off. He informed the meeting that such areas are unlikely to amount to more than 20% of Yalelo’s plot. He also assured the meeting that Yalelo would leave adequate provisions for public access to the lake.

3. Children’s Cemetery
   
a. Mr. Mwale suggested that Yalelo fence off the Children’s Cemetery as a mark of respect and assured residents that no Yalelo facilities would be build immediately adjacent to it. Yalelo would also ensure easy ongoing access to the cemetery.

4. Squatters
   
a. Mr. Mwale informed the meeting that Yalelo did not view it as urgent that squatters move from the Yalelo site as they were at a safe distance from operations. Mr. Mwale suggested that Yalelo offer squatters the option of financial assistance and moving assistance if they would like to voluntarily move to a location off Yalelo’s site. Mr. Mwale stressed that Yalelo was not and would not evict any squatters but hoped that given the offer of financial assistance and the availability of uninhabited land within a few hundred meters or less, that the residents would chose to move freely.

C. Resolutions

2. Lakeshore Gardening Activities:
   
a. It was discussed that there were in the main two families that were involved in gardening of the lake front facing Yalelo’s plot. These are the families of Mrs. Lontiya Muleya and Mr. Justin Matiya. Mr. Joseph Shambulo’s farming activity falls in front of the in the neighbouring property belonging to “Mr. Costain” and was therefore outside the area in question. The meeting resolved to rationalise the use of the lakeshore to accommodate both smallholder activities and Yalelo activities, as the land in question is open to all lakeshore users. It was agreed that all of those
involved should respect every user’s rights and avoid interferences. Yalelo Ltd should seek to minimise other human activities on the Lakeshore land in front of its plot, wherever possible. It was also suggested by residents and agreed to by Mr. Mwale that Yalelo should facilitate the opening of sites for other activities such as washing and cleaning activities in order to retain in as much as possible the sanitary health of the area.

3. Fencing:

a. The meeting recognised the need to accommodate access to lake shore by domesticated and wild animals. It was agreed that fencing should be minimal and only be applied to those installations requiring security and safety of persons and property. The local residents urged Yalelo to provide adequate security because innocent local residents would not want to be implicated in thefts conducted by strangers. At the same time, the meeting agreed that fencing should not be pursued wantonly and for its own sake as the area was also being used by game animals and humans for their own needs. It was resolved that only critical areas requiring fencing for security and safety would be fenced.

4. Children’s Cemetery

a. It was brought to the meeting’s attention that a new planned road (not built, instructed by or involving Yalelo) is expected to be built through the cemetery in the next two years. Regardless, it was agreed that Yalelo would fence off the cemetery to protect it and as a sign of respect. Yalelo again assured the meeting that no development would take place immediately adjacent to the cemetery and that Yalelo would not interfere with the site (except building the fence for local residents). As an aside, local residents discussed finding an alternative site for adult persons for public use, given the probability of the new road. Yalelo assured that to the best of its ability if would ensure all persons would have free access to the new cemetery regardless of status, residence or ethnicity, if access was required via its land.

5. Squatters:

Mr. Mwale reminded the meeting of Yalelo’s desire to find an outcome which did not unwillingly displace squatters. The meeting called on Yalelo to facilitate resolution of this matter as soon as possible and willingly assist whosoever is need of assistance. The meeting recognised the affected parties as being:

1. Alfred Simungulu
2. Abed Simungulu
3. Anteugoes Simungulu
4. Abedinego Simungulu
5. Webster Matiya
6. Amos Gasa
7. Charles Muleya
8. Assizzio Simungulu
9. Richard Simungulu

It was agree that the affected parties would discuss these matters in private with Yalelo immediately following the meeting.
Mr. Mwale on behalf of Yalelo thanked all for attending the meeting. Following a prayer, the Chairman officially closed the meeting at 13:33 hours.

Immediately following the meeting Mr. Mwale and Mr. Mudenda held a discussion with the squatters. It was suggested by Mr. Mwale that each squatter propose a payment sufficient for them to voluntarily move to a nearby site off Yalelo’s plot. The amounts of financial assistance requested were:

1. Alfred Simungulu  K1,500,000  September, 30 2012
2. Abed Simungulu  K1,500,000  September, 30 2012
3. Anteugoes Simungulu  K1,500,000  September, 30 2012
4. Abedinego Simungulu  K3,000,000  September, 30 2012
5. Webster Matiya  K1,700,000  November, 30 2012
6. Amos Gasa  K2,000,000  October, 30 2012
7. Charles Muleya  K3,000,000  September, 30 2012
8. Assizzio Simungulu  K2,000,000  September, 30 2012
9. Richard Simungulu  K2,000,000  September, 30 2012

Total  K18,200,000

Mr. Mwale agreed to these amounts in order to conclude the discussion quickly and to the satisfaction of all parties. Mr. Mwale informed the residents that agreements to note this discussion, and payment, would be prepared and presented in the following days.

Signed: ____________________________________________

Choolwe Mudenda, Secretary
Figure 5: Sample of pictures of shelters and huts of persons displaced by the project. 13/05/2012
Appendix 8: EIA Stakeholders Consultative Meeting 30.01.2012

MINUTES OF THE FIRST ENVIRONMENTAL IMPACT ASSESSMENT (EIA) STAKEHOLDERS CONSULTATIVE MEETING FOR YALELO LIMITED.

DATE: 30TH JANUARY 2012

VENUE: LAKE VIEW LODGE- SIAVONGA DISTRICT

Agenda

1. Registration of participants
2. Opening prayer
3. Introductions
4. Opening remarks by the Chief Operations Officer-EM
5. Presentation on Yalelo Limited by the Chief Executive Officer-FPM
6. Tea break
7. Open discussion
8. Any other business
9. Closing remarks & prayer
10. Lunch break
11. Departure
1. PARTICIPANTS REGISTRATION

In attendance were his Royal Highness Chief Simamba, village headmen from the surrounding communities and their subjects of Kamimbi, representatives from: Department of Fisheries, Zambia Wildlife Authority (ZAWA), Zambia Environmental Management (ZEMA), Church leaders and the Councillor for Simamba Ward as detailed in the attendance list attached.

The meeting opened at 09:45hrs with prayer from one of the participants and Mr. Phanwel L. Simamba was chosen as an interpreter for the meeting.

2. OPENING REMARKS

The Chief Operating Officer (COO), Mr. Edward Manda (EM) welcomed the participants and urged them to feel free and participate fully in the meeting. He then went on to explain the objective of the meeting that was mainly aimed at addressing and taking into consideration any concerns that stakeholders may have with regards to Yalelo Limited setting up cage aquaculture/fish farming operations on Lake Kariba in Kamimbi area of Siavonga district. Mr. Manda then informed the participants that the full details of the fish farming operations for Yalelo Limited would be presented by the Chief Executive Officer (CEO) Mr. Fisho Patrick Mwale (FPM).

3. SPEECH BY CHIEF EXECUTIVE OFFICER (CEO)

After the opening remarks, Mr. Manda invited the CEO who recognized all present and quickly went on to explain what Yalelo Limited was all about. He begun by mentioning that Yalelo Limited was fully owned Zambian aquaculture company with intentions to undertake fish farming activities using cages on lake Kariba and with on shore operations at its site in Kamimbi area. Mr. Mwale explained to the audience that brand name YALELO literally meant today’s fish or today’s company...implying the company will produce and supply quality fresh fish to its outlet markets. The CEO then proceeded to inform the participants that the fish would be raised in circular cages with specifications of 20meters diameter and 9meters water depth. It was further mentioned that the fish to be produced would be for the markets outside Siavonga district targeting major big towns like Lusaka, Kitwe, Livingstone etc. He further told the gathering that in the pilot phase, the company will start with two cages and scale up to 48 cages at the company’s full operation capacity in the fourth year.

The CEO went on further to inform the gathering that Yalelo Limited would operate within the national laws, culture, tradition and norms of the local community in its operations. He also informed the participants that the company would be there to make profit and that the benefits would then be extended to the local community through various social empowerment investments such as health and education facilities which will be provided to its workers. However, he was quick to mention to the gathering that the company will employ people from the local community for most of the jobs as one of the first benefits to the community and that where the job needed qualified personnel especially for specialized jobs, the company will look for people from elsewhere for such staff. He then proceeded to talk about the directorship of the company where Mr. Adam Taylor was introduced to the gathering as the investor in the company as well as the Director and that he himself (FPM) was the CEO of the company with 10% shares. It was further mentioned that after five years, the company will be sold to the indigenous Zambians. The CEO concluded his address by informing the participants that Yalelo
limited would employ best management practices in its operations in order to avoid environmental degradation and at this stage the meeting was opened for discussion.

4. OPEN DISCUSSION:

- **Village headman Mandondi wanted to know if the local fisher folks would be allowed to fish around the Yalelo cages.**

  The COO responded that fisher folks would not be allowed to fish in and around Yalelo Limited cages for fear of thefts. But however, some passage near the cages would be allowed for the fishers as they move to and from their fishing grounds. It was further explained by the CEO that fish farming in cages will be done quite some distance off the lake shore in deeper waters and that where the cages will be placed, there will be clearly marked buoys/markers so that people/fisher folks can clearly see the boundary. This was further exemplified by Mrs Gladys Pieterse who mentioned that there are statutory instruments for aquaculture where it’s not allowed for fishers to set nets in the 100 meters radius of the cages.

- **Mrs. Gladys Pieterse from Lake Harvesters wanted to know the exact location where the cages will be placed and whether placement of the cages won’t take away all the fishing grounds for Kapenta fishers.**

  The CEO Mr. FPM responded that a lot of consultations and site markings had already been undertaken to make sure that the earmarked site for Yalelo cages was a suitable site and that all other stakeholders interests were taken care of. It was further explained that very clearly marked buoys will be in place for people to see Yalelo cage site.

- **Mr. Charles Halubanje wanted to know whether people will be allowed to use the canal dug by Yalelo Limited.**

  The COO, Mr. Edward Manda responded that as long as the canal/harbor was free, people were free to use it with their boats especially during the dry season when the water recedes and the fact that the lake shore around Kamimbi area was generally shallow. This was the more reason why the canal had to be provided for easy loading and offloading fish feeds and other goods.

- **Mr. Dyson C. Tembo wanted to know the modalities of employing the local people that is whether people will have to apply or the company has a prescribed application forms that people can just fill in.**

  The CEO responded that the company has a duo system of employing its employees, the first being that of specialized jobs with specialized qualifications will be advertised and someone with right qualifications employed after going through the interview process. For these other jobs the local leadership will be involved in the selection process where prescribed forms will be provided for people to apply. It was further emphasized by the CEO that all the jobs will be for the local people and that it will be local people with sober habits and hardworking. Drunkards who unproductive will not be employed because what ought to be known is that the company is there to make profits.
• Mr. Crispin Simwanza from Zambia Environmental Management Agency (ZEMA) wanted to know the exact site for Yalelo Operations, target production in tonnes, size and total number of cages and the kind of fish processing method that the company will employ.

It was explained that the site for land operations for Yalelo was in Kamimbi area which is located about 20-22km from Siavonga town along the road going to Gwena. The CEO also responded that the target annual production was 7000 tons. However, this production would be in phases staggered over a period of four years. Initially the company will start with two cages in its pilot phase and later scale up by adding two cages each month to the total target number of 48 cages in the fourth year. It was further mentioned that these cages will be placed at six different sites and each site will have eight cages. The participants were also informed that the only processing that will take place will be freezing of the fish prior to transportation to all the major cities in the country.

• Mr. Phannel Simamba wanted to know the company’s contribution to the local community (Corporate social responsibility programme) apart from just employment of the local people.

The CEO answered that the company will begin by focusing on the welfare of its employees and later the community. This was because of the fact that when an employee is motivated, productivity is higher and the company can make enough profits that can also be ploughed back into the community.

• His Royal Highness Chief Simamba wanted to know the company’s human resource officer and whether that officer comes from the local area for easy understanding of the cultural needs and aspirations of the local people.

The CEO responded that it was actually an instruction from His Royal Highness and that it shall be implemented as such in as far as employing of local people is concerned. The company will only employ people from outside the community only in a situation where such qualified personnel do not exist within the local community.

• Mrs Gladys Pieterse wanted to know if the interest of Kapenta rigs was taken into consideration and how the company shall handle it.

It was answered that the company shall endeavor to take the interest of all stakeholders in its operations on the lake. This will greatly minimize the conflicts with other operators and where issues arise, dialogue will be promoted so that such issues are resolved amicably. This was because Yalelo has intentions of becoming a big company with a good reputation in all its operations.

• Village Headman Frankson Samende wanted to know the sanitation measures that Yalelo limited had in place for the people who will be operating on the lake.

The CEO explained that Yalelo Limited will provide toilets on the boats for its workers. This will be in adherence to the sanitary regulations that were being enforced on the lake.
His Royal Highness Chief Simamba also echoed similar sentiments. He said that there were a number of kapenta rig operators that have no provision for sanitary facilities like toilets and yet they keep people guarding their rigs the whole day. He wondered where such people went to when they have to answer the call of nature. The other concern that was raised by His Royal Highness (HRH) was that even communities that live along the lake shore lacked toilets. He urged officers from ZEMA and Department of Fisheries to make sure that they carry out regular inspection so that people adhere to sanitary regulations. This was because whatever dirty that is not properly disposed off along the lake shore ends up into the lake during the rainy season through run-off.

It was also learnt that most of the investors or people that have taken up places along the lake shore have fenced off all their sites. This also made it difficult for the local people to access the lake and even to take their animals to the lake to drink water. HRH urged Yalelo Limited not to fall in the same trap as this creates tension with the local communities.

- The Ward councilor for Simamba Mr. Smart Gwanda wanted to know where qualified people will come from in Kamimbi for the company to employ. He also wanted the company to sign a memorandum of understanding (MOU) when it comes to employment so that no people from outside Kamimbi community shall be employed.

With regard to employment the CEO Mr. Mwale unveiled the proposed company structure which was in categories. He assured the participants that consideration would be extended to the community for as long as individuals seeking employment were appropriately qualified. He noted however that certain jobs were specialized and will employ accordingly. As such, there was no need of signing the MOU.

Mr. Adam Taylor, the Director of Yalelo Limited also encouraged the meeting saying unlike Lake Harvest that was trying to cross to the Zambian side, Yalelo engaged Zambians who are highly qualified and better understood the law of the land. He strongly believed Aquaculture in Zambia must be run by Zambians. The project idea originated from within Africa he said and therefore the project being close to the Zambian people. He further informed the meeting that the company would address health and safety issues by providing protective and life saving attire thus abiding with requirements of the law. He further stressed, Yalelo was employing on merit and would pay well to have a motivated work force.

The COO, Mr. Manda equally informed the house that Yalelo has emerged as a consequence of the declining fish catches which the community itself would bear witness to. People were expected to benefit directly through formal employment as well as indirectly through the out-grower scheme. He assured the meeting that Yalelo was not a bogus investor and that will not relax but follow the law to the letter.

- Village headman for Namachembele Mr. Bornwell Koonde wanted to know what Yalelo limited will do to people’s livestock that may stray into the company premises and may destroy property.
The COO responded that Yalelo Limited has 110ha of land and that it had only fenced 1ha where all the company equipment is placed. As such, fears of animals damaging property and equipment does not arise in that that had already been taken care of by fencing the storage place of the company property and equipment. The same goes with the passage of people in the foot paths that pass through Yalelo land were not closed and people were still free to use the foot paths.

• Mr. Lackson C. Chipeleme wanted to know what the company will do with the squatters.

The CEO responded that the land that was allocated to Yalelo Limited has no squatters, its virgin land apart from one or two households on the eastern border of the land. It was further mentioned that these people were illegally settled there without approval the palace council and that they were already given matching orders to vacate the sites. It was further explained that whatever steps that will be taken shall be in accordance with recommendation from the palace council and everything shall be done amicably taking into consideration each other’s interests.

• Mr. Kenny Siamatika wanted to know if the feed that will be fed to the fish will have chemicals that will pollute the water.

The COO responded that the fish feeds will have no chemicals that will pollute the water and the fish itself. The company will use complete formulated pellet feed that will be procured from National milling and Tiger animal feeds.

5. ANY OTHER BUSINESS

Headman Gwena, Mr. Siakwale Cosmas wanted to know why officers from Zambia Wildlife Authority (ZAWA) usually took long to respond when the wild animals like crocodiles, hippos attacked a human beings and that when it’s vice versa, the authority was quick to come and arrest the people. The Wildlife Ecologist from ZAWA, Mr. Maimbo Howard explained that, that was not the case actually with ZAWA in that they always respond on time. It’s just sometimes certain accidents/attacks of animals on people happen or indeed are reported when there is lack of resources to respond to such issues. And when that happen people think that ZAWA does not do anything or delayed in responding to such calls. He went on further to explain that ZAWA also does cropping of animals once per annum in order to regulate the animal population.

His Royal highness Chief Simamba was concerned that there were tendencies in some communities where when land has been allocated to the investor and that that land has been surveyed and beacons fixed, people tend to remove the beacons thereby bringing confusion. He urged the headmen to ensure that such tendencies must be stopped and if anyone is found wanting, he/she must be reported the palace council.

6. CLOSING REMARKS:

HRH Chief Simamba began his closing remarks by first urging village headmen to restrain from being beggars to the investors. He stated that in as much the chiefdom of Simamba has continued receiving Investors; it was wise that the headmen welcomed them responsibly particularly when it comes to seeking assistance. This was because investors were there for
development and employment creation for the local people. He then went to mention that not everybody can be employed considering the large population of Siavonga and that if the company had to employ, it has to be people who are well behaved and qualified for the job.

The further said that where differences arose, dialogue must be encouraged and those that will be employed must work hard for the development of the company. He also mentioned that drunkenness, laziness and theft should never be tolerated. Whoever shall be found wanting must be fired immediately by the company.

HRH also expressed happiness with coming of Yalelo into his chiefdom and that he believed in action. He went on to say that he wants real by Yalelo seen because if it fails his subjects will blame him that he is bringing in investors that are not serious. The chief concluded his remarks by wishing Yalelo all the success and saluted all participants. Finally, the CEO invited every participant for a group photo and thereafter Lunch meal.

Meeting ended at 13:00 with prayer by Mr. Cosmas Siakwale

Proof of Attendance, courtesy of Yalelo Finance Department
<table>
<thead>
<tr>
<th>Name of Participant</th>
<th>Designation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Anna Banda</td>
<td>GIS Specialist</td>
</tr>
<tr>
<td>2. Bornwell Koonde</td>
<td>Headman Namachembele/Kamimbi Village</td>
</tr>
<tr>
<td>3. Charles Sialubanje</td>
<td>Simamba Traditional Council Chairperson</td>
</tr>
<tr>
<td>4. Chief Simamba</td>
<td>Traditional Chief of the Ba-Gande Clan</td>
</tr>
<tr>
<td>5. Choolwe Mudenda</td>
<td>Consultant</td>
</tr>
<tr>
<td>6. Cosmas Siakwale</td>
<td>Simamba Traditional Council</td>
</tr>
<tr>
<td>7. Dyson Tembo</td>
<td>Farmer</td>
</tr>
<tr>
<td>8. Edward Manda</td>
<td>COO Yalelo</td>
</tr>
<tr>
<td>9. Fisho Mwale</td>
<td>Chairman and CEO Yalelo</td>
</tr>
<tr>
<td>10. Frankson Samende</td>
<td>Village Headman</td>
</tr>
<tr>
<td>11. Gladys Peters</td>
<td>Kapenta Association</td>
</tr>
<tr>
<td>12. Gordon Mudenda</td>
<td>Consultant</td>
</tr>
<tr>
<td>13. Headman Mandomdi</td>
<td>Simamba Traditional Council</td>
</tr>
<tr>
<td>14. Justin Mapulanga</td>
<td>Farmer</td>
</tr>
<tr>
<td>15. Kenny Siamatika</td>
<td>Farmer</td>
</tr>
<tr>
<td>16. Meebelo Wamulume</td>
<td>Fisheries Officer</td>
</tr>
<tr>
<td>17. Mr. Crispin Simwanza</td>
<td>ZEMA Officer, Chirundu</td>
</tr>
<tr>
<td>18. Mr. Lackson C. Chipeleme</td>
<td>Villager/Farmer</td>
</tr>
<tr>
<td>19. Mr. Maimbo Howard</td>
<td>ZAWA Officer, Chirundu</td>
</tr>
<tr>
<td>20. Phanuel Simamba</td>
<td>Simamba Traditional Council</td>
</tr>
<tr>
<td>21. Smart Gwanda</td>
<td>Ward Councillor</td>
</tr>
</tbody>
</table>
Appendix 9:  Terms of Reference for the EIA Study

List of Acronyms

EIA  Environmental Impact Assessment
EPB  Environmental Project brief
GRZ  Government of the Republic of Zambia
NADP  National Aquaculture Development Plan
NADP  National Aquaculture Development Plan
NAqS  National Aquaculture Strategy
NEAP  National Environmental Action Plan
SADC  Southern African Development Community
SEA  Strategic Environmental Assessment
ZEMA  Zambia Environmental Management Agency
1.0 Introduction

The Scoping Report presents the terms of reference and the outline of the EIA report. The scoping report describes the proposed activity and explores any feasible and reasonable alternatives. It also describes the property that the proposed activity is located and the nature of the environment that may be affected. This includes the manner in which the biological, social, economic and cultural aspects of the environment may be impacted by the proposed activity. The scoping report is the first and most critical stage of the EIA process because it reviews the environmental issues and potential impacts, including cumulative impacts that can be foreseen and the details of the public participation process undertaken. In addition, the Scoping Report contains a roadmap for the Environmental Impact Assessment, referred to as the Plan of Study for the EIA, specifying the methodology to be used to assess the potential impacts, and the key specialists to carry out the study and the specialist reports to be examined.

Scoping is the process of identifying the key environmental issues and is probably the most important step in an EIA because several stakeholders, particularly decision makers, the local population and the scientific community are interested in the issues addressing and scoping is designed to canvass their views. Furthermore, scoping is important because it pinpoints the problems to be addressed, permit design changes to the project so that negative impacts are either minimised or avoided altogether before the start of the project. Scoping enables the EIA study to focus only important issues. It is not the purpose of an EIA to carry out exhaustive studies on all environmental impacts of projects. If key issues are identified and a full scale EIA is considered as necessary then the scoping should include terms of reference of the EIA study.

The scoping exercise identifies the key interest groups, both governmental and non-governmental, and establishes useful lines of communication with people that are affected by the project. Consultations with communities draw upon their knowledge and views on issues that are applicable to the project and are the focus of the EIA. The needs and views of the affected population have been enlisted into this report by use of rapid participatory rural appraisal techniques involving focused group discussions with community representatives drawn from Chief Simamba, Government and Local Government representatives, as well as meetings with residents of Kamimbi Village in addition to bilateral interviews with key informants.

The report relies on information that has been collected using baseline studies of the physical environmental, a checklist for social and cultural impact assessment and matrices for presentation of findings. These techniques collect and present knowledge and information in a straightforward way so that logical decisions can be made about which impacts are most significant.

The rest of this report is organised as follows: next is an overview of cage culture in Zambia and Lake Kariba. The overview is followed by a presentation of the regulatory framework for cage culture in Zambia. This is followed by a description of the project, its location and the surrounding environment the project may affect. Next is a review of project development concepts and the reasonable options or alternatives; the nature of the proposed activities. The proposed team of EIA specialists and their tasks will follow, together with, the outline of the EIA study process. The study outline shows the tasks, particulars of the public participation process and the methods of assessing environmental issues and alternatives, including the option of not proceeding with the activity.
1.1 Purpose of Terms of References

The purpose of these Terms of Reference (ToRs) is to provide background information and guidelines for conducting an environmental impact assessment related to the proposed project and in line with Zambia’s development environmental laws, particularly, the Environmental Management Act, 12 of 2011 and other related legislations.

The Environmental Impact Assessment (EIA) will highlight both positive and potential negative impacts of the project and how these impacts will be mitigated. This study will review the environmental and social impacts the project is likely to exert on the Siavonga Town Area and its environs, and to a lesser extent in Zambia.

In order to develop these TORs, Yalelo has undertaken an environmental and socio-economic scoping mission to the project area as well as an institutional survey with relevant agencies in Lusaka and a number of key stakeholders have been consulted for their input into the structure and content of an EIA and subsequent preparation of the Environmental Impact Statement (EIS). The process culminated into the holding of a stakeholder meeting on the 30th January, 2012. The minutes of the meeting and the stakeholders attendance list are attached as Appendices 8. Generally all the stakeholders welcome this investment and would be glad to have the project start as soon as possible. There are some environmental and socio-economic issues that need addressing before Yalelo project is implemented.

The preliminary environmental issues that have been identified and should be addressed by the project include:

- Need for accommodation of other lake and shoreline users, fishers and gardeners;
- Disposal of wastes and management of waste water;
- Protection of fish biodiversity by avoiding introduction of new species;
- Need to follow Best Practices in Fisheries and aquaculture and applying ecosystem approach;
- An affirmative employment policy in favour of local residents;
- The need to acknowledge the interests of other members of the community by working in harmony with others;
- Consideration for the families that maybe more directed affected by the project;
- Support to community initiatives and community health service improvement.

These preliminary issues raised by stakeholders are a significant component of the issues to be addressed by or to be incorporated into the EIA and the EMP.
2.0 Overview of Cage Aquaculture in Zambia and Lake Kariba

Aquaculture in Zambia is still expanding in all the nine provinces of the country. The main form of fish culture is in earthen ponds which account for 80% of aquaculture output, while fish cage culture is relatively a new practice and accounts for 4% of production. The balance is from utilisation of small water reservoirs which is considered as extensive aquaculture because the fish is stocked and not naturally recruited. This culture system accounts for 16% of aquaculture production and is concentrated in drier Southern and Eastern provinces, where such reservoirs and culture systems predominate.

Lusaka province is the leading producer of farmed fish and accounts for 23% of output. Most of this is however produced by one farm, Kafue Fisheries Ltd, probably the largest fishpond farm in Africa. Lusaka province is followed by Northern and Southern provinces producing 17% of national output each. Eastern province accounts for 16%, above the Copperbelt province which produces 14% of national aquaculture production. Luapula, North-western and Western provinces have lowest production levels with a combined production of 8% of national output. Table 1 below summarises the structure of aquaculture production according to culture systems.

Table 1: Structure of Aquaculture Production in Zambia by Culture System

<table>
<thead>
<tr>
<th>Description</th>
<th>Fish ponds</th>
<th>Small reservoirs</th>
<th>Cage culture</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Percent</td>
<td>80%</td>
<td>16%</td>
<td>4%</td>
<td>100%</td>
</tr>
<tr>
<td>Tonnes</td>
<td>6,800</td>
<td>1,360</td>
<td>340</td>
<td>8,500</td>
</tr>
</tbody>
</table>

Source: Department of Fisheries Estimates, 2009

Aquaculture in Zambia is highly concentrated. About 24 fish farmers account for nearly 48% of aquaculture production, while the rest is attributed to nearly 6,000 small scale subsistence fish farmers with 13,000 fish ponds.

The National Aquaculture Strategy recognises the need industrial producers in Zambian aquaculture to quickly overcome the critical binding factors to aquaculture development: shortages of seed and feed restricting the development of viable small enterprises. The National Aquaculture Strategy welcomes involvement of large industrial producers and encouragement of commercialisation of the small scale fish farmers which can create a critical mass of producers that can support diverse rural livelihoods and at the same time contribute to meaningful poverty reduction among rural farmers.

In line with the national strategy, the National Aquaculture Development Plan (NADP) seeks to jump start fish production and provide necessary support to industry through establishment of large commercial operations and clusters of small and medium scale cage culture operators initially on Lake Kariba. With time, these operators are expected to grow and expand their businesses, provide employment and ultimately income and food resources that the country needs.

Cage culture in Zambia was first introduced in 2000 on the Zambian side of the Lake. This became a possibility because of the establishment of a commercial Nile Tilapia hatchery in Chirundu. This led to an immediate positive response by an animal feed producer to start producing fish feeds. Despite heavy reliance of cage culture system on inputs; feed, hatchery seed, cage culture has established itself as the most cost effective intensive culture system available in Zambia. However, negative perceptions that surrounded the introduction of cage culture have considerably discouraged
expansion. There are concerns in some quarters that this culture system could, if not ably regulated, threaten the integrity of the Lake through escapees of ‘alien’ species and the spread of diseases from culture facilities into the environment. These apprehensions are partially responsible for the slow growth of cage culture, despite its potential for rapid expansion. Today, cage culture operations on Lake Kariba continue to be modest and are carried out by a handful of small scale producers.

The NADP (2010-2014) recognises the critical role of cage culture in Lake Kariba for meeting Zambia’s fish supply shortfall. The GRZ Strategic Environmental Assessment Study Report for cage culture development plan in Lake Kariba (2010) reveals that the potential for cage culture in Lake Kariba is so huge as to be excessively adequate for meeting Zambia’s present needs and those in the foreseeable future if it is fully developed. For this reason, the national aquaculture development programme assigns priority role of Lake Kariba in the development cage culture in Zambia. It is now recognised that Lake Kariba provides Zambia with sufficient resources for bridging the fish consumption deficit and possibility of increasing fish exports to the region.

In spite of encouraging possibilities, cage aquaculture development in Lake Kariba faces limitations. For instance, the few authorised operators have continued to suffer losses due to damage of their installation by rough waves during stormy episodes. This is obviously a result of inadequate guidance on suitable site selection and cage facility designs.

In order to ease entry into cage culture and avoid conflicts among lake users, the Government and the Local Authority have designated a number of sites for cage culture. One such site is Kamimba bay, where Yalelo proposes to locate fish cages. The policy to designate selected areas for cage culture is expected to ease potential for conflict between farmers on one side and commercial fisheries and other recreational activities.  

Aquaculture depends on a health environment to succeed. Cage culture farms need to institute self policing practices to maintain environmental health that is needed for profitable operations. The management of the farm must have an unremitting environmental monitoring and evaluation system from the very beginning and throughout the project life cycle in order to be truly sustainable.

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29 The first national cage operator, Lake Harvesters Ltd faced this problem see *Sunday Times of Zambia* Newspaper report on cages in Lake Kariba 2004 “Ban cage Fishing – Farmers” By Sunday Times Reporter
3.0 The Regulatory Framework for Cage Culture in Zambia.

Legal and environmental implications of aquaculture relate to geographic and social factors and also technical (biological) norms. Because fish farming is an aquatic activity, the key laws and regulations pertain to water quality as this is the major environment of this industry. The legal framework is therefore anchored in fisheries and environmental management regulations. Below is a list of legislations that touch one or more issues connected to management of the aquaculture industry.

<table>
<thead>
<tr>
<th>Legal Instrument</th>
<th>Issues</th>
<th>Key (Competent) Authorities</th>
</tr>
</thead>
<tbody>
<tr>
<td>The Fisheries Act No. 22 of 2011</td>
<td>- Planning and licensing, control of live fish movements and introductions - Best Aquaculture Practice Guide - Security of aquaculture facility</td>
<td>Director of Fisheries Department</td>
</tr>
<tr>
<td>Food and Drug Act (CAP 303).</td>
<td>- Fish food safety standards</td>
<td>Department of Health</td>
</tr>
<tr>
<td>Town and Country Planning Act Cap 283</td>
<td>- Planning permission</td>
<td>Department of Town and Country Planning, Local Government Administrator</td>
</tr>
<tr>
<td>The Lands Act of 1995</td>
<td>- Conversion of Titles - Security of tenure for land based facilities - Land reservation</td>
<td>Commissioner of Lands, Local Government Administrator, Area Chief and Village Head, Registrar of Lands and Deeds</td>
</tr>
<tr>
<td>The Water Act (1949)</td>
<td>- classifies water for “pisciculture” as a secondary use right - Water rights allocation to impoundment and storage or diversion</td>
<td>Department of Water Affairs</td>
</tr>
<tr>
<td>Water Pollution Control (Effluent and Waste Water) Regulations (1993),</td>
<td>- Prohibits the pollution of any public water - Establishes water quality and pollution control standards - Sets conditions for the discharge of effluents into the aquatic environment.</td>
<td>Zambia Environmental Management Agency and Department of Water Affairs</td>
</tr>
<tr>
<td>The Environmental Management Act Number 12, of 2011</td>
<td>- Protection of the environment and the control of pollution - Regulation of Environmental Impact Assessments</td>
<td>Zambia Environmental Management Agency</td>
</tr>
<tr>
<td>Stock Diseases Act CAP 252 [27th December, 1963]</td>
<td>- Regulates importation and movement of stock; - Provides for quarantine regulations</td>
<td>Director of Veterinary Services</td>
</tr>
<tr>
<td>Agriculture (Fertilisers and Feed)</td>
<td>- Regulates stock feeds and</td>
<td>Director of Agriculture</td>
</tr>
<tr>
<td>Act (CAP 226)</td>
<td>fertiliser applications</td>
<td>Department</td>
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</tr>
<tr>
<td>Local Government Act CAP 281</td>
<td>- Regulates out-grower</td>
<td>Local Government Administrator</td>
</tr>
<tr>
<td></td>
<td>- Settlements and</td>
<td></td>
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<td></td>
<td>resettlements</td>
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<table>
<thead>
<tr>
<th>Legal instrument</th>
<th>Issues</th>
<th>Key (Competent) Authorities</th>
</tr>
</thead>
</table>
- Regards the safety, health and welfare of persons employed therein;  
- Provides for the safety, examination and inspection of certain plant and machinery | Inspector of Factories |
| Chapter 466: Inland Waters Shipping Act, Government Notices 249 of 1964, 497 of 1964 | - Provides for registration and safety of vessels used on inland waters of Zambia, for the safety of passengers and cargo, for the competency of masters and crews, Life-saving appliances to be carried | Minister of Transport, Zambia Police and Local Government Administrator |
| Chapter 173: National Heritage Conservation Commission 23 of 1989 and 13 of 1994 | - An Act to repeal and replace the Natural and Historical Monuments and Relics Act and to provide for:  
- conservation of ancient, cultural and natural heritage, relics and other objects of aesthetic, historical, pre-historical, archaeological or scientific interest;  
- Regulation of archaeological excavations and export of relics. | Director, Conservation Commission of Zambia |

Like any other industry, aquaculture and its products are regulated by the Local Government Act which grants powers on local authorities to enact by-laws for the efficient administration of local councils. This includes by-laws on levies which may have a direct bearing on farm operations. Local authorities also have powers to regulate out grower schemes within their jurisdictions and impose levies.
4.0 Description of the project

The project involves development of a fully integrated cage culture fish farm and fish processing operation. A phased approach will be taken to ensure all activities are implemented reliably and in accordance with best practice. Core ‘grow-out’ activities will begin with without a hatchery, feed mill or processing plant. Within 24 months each of these facilities will be developed.

At full scale, the project will consist of:

- 48 floating ‘grow-out’ cages, capable of producing 7,000 tonnes per year
- A 50 pond hatchery, capable of producing 27.5 million fingerlings per year
- A feed mill capable of producing 15,000 tonnes of aquafeed per year
- A processing plant, capable of processing 7,000 tonnes of fish per year

Each of these components is described in further detail below.

The size of the proposed circular grow-out cages are 20 meter circumference with 9 meters depth, giving a volume of 2,826 m$^3$ and 25 meters diameter with 6 meters depth, giving a volume of 2,943 m$^3$. The cage material is high-density polyethylene (“HDPE”) piping and brackets. Two nets will be used for fish containment below water with one ‘bird net’ above water. Nets will be made of HDPE and Nylon. In line with Fisheries Department recommendation, it is proposed to mark 100 meters of cage perimeter with buoys. Each cage site consists of eight cages, with each cage covering an area of 314 and 490 m$^2$ for 20 meter and 25 meter diameter circular cages respectively. The total surface area to be covered by cages is 22,134 m$^2$ upon complete expansion, which is 0.022 square kilometres. Lake Kariba has a surface area of 5400 square kilometres; therefore the proposed cages will cover less than one fifty-thousandth of the lake surface.

The initial focus of the company was on the core task of successfully growing out fish in off-shore cages, which has been recently accomplished under the approval of the Yalelo EPB. A hatchery and feed mill will now be developed to ensure supply-chain stability. In year three, a processing factory will be constructed to enable exports of process fish to surrounding countries. Yalelo expects to develop operations according to the following schedule:

**Phase One (Immediately following EIA approval):**

- Approval of Environmental Impact statement and aquaculture license. Offshore cage production of up to 7000 tonnes of tilapia per year.
- Establishment of onshore hatchery production of up to 30 million fry and fingerlings per year for stocking the offshore cages.
- Commencement of fish sales in Zambia.
- Limited processing to include freezing and gutting of up to 3,500 tonnes of fish per year.

**Phase Two (2013, following Phase 1):**

- Establishment of a 15,000 tonnes per annum extruded floating pellet feed manufacturing plant on site.
- Full processing (filleting, canning, flavouring etc.) of fresh and frozen fish.
- Export to neighbouring countries
Normalized operations upon full completion of Phase 1 and Phase 2 will consist of:

- Fingerling production of 27.5 million fingerlings per year (2.3 million per month) stocked in 8 x 2,827 m$^3$ and 40 x 2,943 m$^3$ floating cages. The hatchery, on-shore, will consist of 50 ponds.

- Production of between 6,960 and 7,200 tonnes of fish per annum from two crop cycles of 3,480 and 3,510 tonnes each.

- Expected yield is from 30 to 35 kg of fish per cubic metre from 11.6 ha of water surface area representing output of 3,480 and 3,510 tonnes of fish per crop depending on initial stocking sizes and survival rates.

- Approximately 4,000 tonnes will be frozen and gutted and 3,000 tonnes filleted.
5.0 Project Location

The project is located 24 km north-west of Siavonga Township west of Kamimbi Fishing Camp on Lake Kariba. Lake Kariba is a reservoir created to generate electricity for Zambia and Zimbabwe. The two countries regulate the management of the Zambezi watershed, including the Lake itself, through the Zambezi River Authority. Zambia and Zimbabwe have a bilateral agreement for the joint management of Lake Kariba and its environs. By acts of parliament in Zambia and Zimbabwe, a Zambezi River Authority (ZRA) was established in 1995. Even though the authority is responsible for water quality management, water abstractions from the lake and the river upstream, as well as for the monitoring of effluent emissions into the lake, it has no means of its own to enforce this mandate except through jurisdictions of riparian states. The environmental management of the lake in Zambia is the responsibility of the Zambia Environmental Management Agency.

The production facilities are located on the following coordinates.

### Table 19: Geographic Coordinates of Proposed Cage Sites

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<thead>
<tr>
<th>SITE 1</th>
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<td>E 028 38.979</td>
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<tr>
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<td>DEPTH</td>
</tr>
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<table>
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<td>30.1M</td>
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<tr>
<td>E 028 39.307</td>
<td>TEMP 29.1</td>
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<tr>
<td>POINT C</td>
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<td>E 028 39.352</td>
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<table>
<thead>
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</thead>
<tbody>
<tr>
<td>POINT A</td>
<td>DEPTH</td>
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<tr>
<td>E 028 .64.168</td>
<td>TEMP 29.2</td>
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<tr>
<td>POINT C</td>
<td>DEPTH</td>
</tr>
<tr>
<td>E 028 .64.215</td>
<td>TEMP 29.2</td>
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</table>

The sites indicated above lie over 15 km radius of the Lake. Each cage site consists of four cages, each covering an area of 140 m$^2$. The water depth ranges from 25 to 44 metres.

Environmental and socio-economic issues associated with each component shall be detailed in the EIA report. The mitigation measures and monitoring program shall be presented in the EMP.
6.0 Description of the environment

The project activities will be on-shore and off-shore activities. The environmental conditions of the Lake Kariba are now considered as being stable and are not expected to change from year to year. However, the Lake experiences seasonal variations in its physic-chemical properties. Generally temperatures in Siavonga and around the Lake Kariba are typical of the hot dry valley conditions (ranging from 23°C to 29°C). (SADC, 2007). The Project is set in a typical Mopane vegetation type.

6.1 Bio-physical Characteristics of the Project Area

The detailed EIA study will gather, evaluate and present baseline data on the relevant environmental characteristics of the study area such as suffice to state the study will include bio-physic-chemical and human environment and associated indicators including culture, economics, and health. Some biophysical characteristics that will be looked at include data such as on; climate such as rainfall, temperature and sunshine. The EIA shall not study air quality of the project area because neither the project nor the ambient air will affect the project. What is of interest to the project is wind current. Similarly, any reference to geology will be in respect of the seismic threats, this is an unavoidable risk that all those in Siavonga and Lake Kariba surrounding and beyond face.

Otherwise the EIA will examine topography, land use, land tenure, landscape, fauna, flora, and human environment. A preliminary investigation shows that the project area has no known archaeological and fossil sites. The EIA will not waste effort on this aspect either.

6.2 Determination of Potential Impacts of the Project

The determination of impacts will be in line with international practices where risk and probability of occurrence as well as magnitude are qualitatively assessed using expert judgement. Where possible the EIA will quantify impacts.

Using a check-list, significant positive and negative impacts shall be identified during the EIA process. The determination will also look at direct and indirect impacts and whether they are short term or long term. Significance of impact shall be determined using internationally accepted tools such as used by the UN FAO in aquaculture projects.

In any development project, some negative impacts are inevitable but what is more important is their identification at an early stage. The EIA and its EMP are important tools for identification and management of such identified impacts and will be used in this project to identify and where possible quantify costs and benefits to the environment.

6.3 Incorporation of views of stakeholders

As a responsible developer, transparency and open consultation is one of the guiding principles of Yalelo Ltd. This has been demonstrated in the elaborate and long period of consultation with as many possible stakeholders as it could. The views of stakeholders shall be incorporated into the report as at every stage of project implementation.
6.4 Analysis of Alternatives

By definition, aquaculture entails use of water to culture an organism. However, depending on scale of production, not all production technologies are economically viable, socially acceptable or environmentally tenable. The assessment of the project alternatives include the without the project option as well as alternatives at location, species and culture system levels. Fishpond culture is first the best option for hatchery operations and the least for grow out. Offshore nursery operations are ruled out for primary nursery, but best option for secondary nursery operations. Kamimbi site is best option in terms of proximity to the market and location in the oligotrophic zone 4. The other options are at species level and Nile tilapia is proposed because it is already present in the lake and its biology well known.

6.5 Environmental Management Plan (EMP), Roles and Responsibilities

The Environmental Management Plan (EMP) shall be produced as part of the EIA report and it shall identify and propose mitigation measures and preventive actions to be taken during the project implementation. The EMP shall also specify the environmental management and social monitoring arrangements.

Baseline data will be used in project environmental impact monitoring. The environmental monitoring during project implementation will also provide information on the effectiveness of the proposed mitigation measures. The major environmental parameters to be monitored include both bio-and physic-chemical and socio-economics. Therefore the existing sampling points used for baselines will be included among the other monitoring stations/points. The frequency of monitoring shall be modelled according to Department of Fisheries and ZEMA guidelines.

Specifically, the monitoring section of the EMP will elaborate the requirements of the industry as provided by the Best Management Practice guide for cage culture GRZ/ZEMA 2010). This section will indicate the parameters to be measured and methods to be used including determined thresholds, that will signal the need for corrective actions; sampling points which will be the same as those for baselines; schedule and frequency of measurements and monitoring and reporting procedures to ensure early detection of conditions that necessitate mitigation and furnish ZEMA or the competent authority with information on the progress and results of the mitigation.

6.5.1 Roles and Responsibilities

The EIA Report and the EMP will assign clear roles and responsibility for each mitigation measure that will have been identified. This is essential to the undertaking of effective mitigation measures that are necessary to minimize adverse impacts but also to enhance positive impacts. Yalelo Ltd will develop an EMP as part of its environmental and social responsibility or stewardship.

6.5.2 Expertise Required for the Project

The project has impacts on aquatic resources and society. The expertise and therefore the EIA team consists of a social scientist with a background in aquaculture and environmental economics; an aquatic ecologist (limnology) with additional fisheries biology qualifications. The cartographer will contribute geographical positioning and mapping technology to the team.
Therefore, the structure of the study team comprises:

1. Social, economic assessment and Team Leader Mr. Choolwe G. Mudenda
2. Fisheries and Aquatic Ecologist – Mr. Hangoma G. Mudenda
3. Cartographer – Ms. Anastasia Banda

6.6 Environmental Issues

6.6.1 Physical Environment

The preliminary environmental issues that have been identified and should be addressed are as follows:

- Pollution from fish feed and fish processing wastes in the Lake
- Discharge of wastewater from ponds and fish processing plant
- Solid waste from fish processing
- Impacts of escapees on Lake biodiversity and species introduction
- Application of Best Aquaculture Management Practices to the project
- Impact of cage culture on fisheries resources

6.6.2 Socio-Economic Environment

- Evaluate the impacts of the project on existing resource use practices and mitigation options
- Describe the positive and negative socio-economic impacts of the project on the environment and measures to reduce/avoid negative impacts;
- Assess potential conflicts among land users and assist developer in negotiating an acceptable resettlement framework for unauthorised settlements in the project area
- Work in harmony with other Lake users including such as fishers and shoreline gardeners
- Assess potential conflict between artisanal fishers and Kapenta fishing vessels and their gears and cage culture facilities.
- Address all the preliminary issues raised by stakeholders for incorporation into the EIA and the EMP.

In order to prepare this Scoping and TORs Document, the Consultant and the developer, undertook a physical visit to the project site as well as the surrounding environs. This was necessary to understand the bio-physical as well as the socio-economics of the project area.

This Scoping and TOR report has been prepared for consideration and approval of the Zambia Environmental Agency (ZEMA). This document is part of the initial requirements for conducting an EIA and started with a screening exercise based on the general principle criteria set under the EIA Regulations Number 28 of 1997 and scoping phase during which different stakeholders were consulted and relevant documents reviewed in order to guide the preparation of the EIA Report or the EIS Report including the EMP which shall be part of the EIS document whose implementation may be considered part of conditions of approval of the EIA for this project. Yalelo will adhere to the best international practices and guidelines.
7.0 Checklist for the Preparation of the Yalelo EIA Study

1. Title of Proposed Development
2. Names and addresses of proponents
3. Executive Summary
   i. Background and the need for the proposal
   ii. Summary of pre-construction, construction and operational activities
   iii. Overview of existing regional and local environment
   iv. Description of likely impacts of the proposal on the environment during pre-construction, construction and operational phases;
   v. A statement of the environmental protection measures, safeguards and monitoring procedures to be implemented for the proposal.
   vi. Outline of alternative processes that could impact less negatively
   vii. Signatures of authors of the environmental impact study
4. Introduction and Terms of Reference
5. Broad objectives and Scope
   i. Statement of objectives which have led to the development of the proposal;
   ii. Outline of alternatives, timescale for implementation and project life;
6. Justification of the Proposed Project
   i. Outline of the strategic and environmental implications of the proposed project, including present and future fish production and consumption – from capture and culture
   ii. Describe long term strategic implications of the proposal in terms of fish supply network throughout Zambia
   iii. Economic analysis of the project, detailing financial viability – annexed to the document;
   iv. Regional and social impacts including employment consequences.
7. Legislative Requirements and Approvals
   i. The legislative basis of EIA
   ii. List legislations and approvals – national and regional – which ever applicable
8. Methodology
   i. Description of results of consultations
   ii. Describe methods used to obtain information
9. Procedure for the assessment
   i. Detailed plant and animal surveys
   ii. Current status of fish in natural waters and around the proposed site
   iii. Reference standards and comparative documentation;
   iv. Measurement criteria and recording techniques, including language translation and details of formulation of records.
10. Methods of data accumulation and analysis (in detail)
   i. Data accumulation methods to include but not limited to visual inspection, sampling, measurements, interviews and retrieval of existing records and documents.
   ii. Data analysis methods to include but not limited to those relating to arrangements for the testing of samples by laboratories; those dependent upon judgement or
opinions of other specialists, reference materials - previous reports, learned papers etc – comparisons to standards, specifications and regulations.

11. Impact Assessment
   i. Significance of identified impacts;
   ii. Probability of impacts and consequences
   iii. Ranking of impacts according to severity, scale and duration of impacts
   iv. Identify impacts to be managed and prioritise according to significance.

12. Schedule for quantities
   i. Schedule of quantities of measures to correct identified problems

13. Visits to project site
   i. Nature of work for each visit should be identified, resources required and documentation and records investigated

14. Description of baseline environment
   i. Maps showing project location, sampling sites and current land use in the proposed project area, vegetation, ecosystems
   ii. Table of properties of land used for different purposes and evidences of abuse if any should be included
   iii. Survey of soils, plants and animals – endangered, threatened, rare or vulnerable species.
   iv. Description of mammals, birds, reptiles, amphibians, fish, arthropods and molluscs of economic importance in terms of human and animal health
   v. Specify large mammals and birds that may no longer exist
   vi. Survey of fish species in natural waterways and tributaries passing though the project area/site;
   vii. Wetland survey if any;

15. Description of the proposed Aquaculture Project
   i. Background information - new, extensions, alterations and abandonment
   ii. Geographic context
      a. Identify possible conflicts
      b. Illustrate farm design and present alternatives if necessary;
      c. Present preferred site and layout – specify, residential, plant areas, water sources; aquaculture facilities; roads, rail reserve areas
   iii. The Fish farm
      a. Describe the fish farm design parameters – pipes and other materials to be used during construction and other supporting infrastructures;
      b. Indicate potential options for future extensions and projected demands for land, water and infrastructure.
      c. Fish farm construction and construction programme – including alternatives; i.e. manual versus mechanical works and description of machinery to be used.
      d. Define critical factors and impacts of fish farm construction – include land clearing, excavations, construction of embankments etc.
      e. Advise on possible interruption of fish farm construction such as heavy rains, floods, authorisations etc.
f. Methods of testing the fish farm integrity – flood proof status and prevention of escapes.
g. Operational and maintenance requirements – surveillance frequencies;
h. Species of fish proposed for use – indigenous and exotic;
i. Whether fish is already in use or to be introduced;
j. Types of fertilisers;
k. Types of hormones, drugs etc.
l. Water availability
m. The farm system and reasons for that;
n. Recommended methods for disposal of unwanted – live and dead fish from the farm;
o. Measures to prevent escape
p. Measures to minimise eutrophication;
q. Types of feeds and feeding regimes;
r. Location of farm facilities in relation to fishery areas;
s. Sources of broodstock and methods to be used to replenish natural populations in case of wild collections;
t. Decommissioning details, duration means and extent, and rehabilitation plans
u. Information on housing, manpower, sewage, refuse

16. Water supply and usage
   i. Usage and waste disposal systems during construction and operational phases

17. Tenures
   i. Tenure
   ii. Land use
   iii. Local Government Planning Permission; applicable conditions;
   iv. Potential acquisition or compensation issues – in case of traditional rights and interests
   v. Consistency of project outcomes with community interests
   vi. List of development approvals or infrastructure proposals likely to be required;

18. Workforce accommodation
   i. Construction and operational phases
   ii. Associated infrastructures
   iii. Site selection issues and locations as indicated on area map

19. Employment and supply of materials
   i. Number of people to be employed and level of skills
   ii. Source of workforce;
   iii. Possibilities of contracting and subcontracts
   iv. Purchasing and procurement strategies during construction and operation

20. Assessment of short, medium and long-term impacts
   i. Effects of the project on:
      a. Physical environment
      b. Landscape
      c. Soils
      d. Water supply
21. Environmental strategies
   i. Land use strategies
   ii. Environmental management system – performance commitments
   iii. Verification of compliance with environmental performance commitments, including permits and licenses

22. Controls and safeguards
   i. Specific safeguards and controls to minimise or remedy environmental impacts – Environmental Management Plan – including
      a. Control measures to minimise impact of construction camps – waste management, pollution control;
      b. Safeguards for minimisation of soil erosion;
      c. Mechanisms for involving local communities in the protection of areas of significance;
      d. Training programmes and employment strategies for local people; and
      e. Opportunities for ongoing involvement of local communities in fish farm operation and possible external commercial arrangements.

23. Monitoring
   i. Monitoring programme
      a. Details of inspections to be undertaken to ensure integrity of the facility;
      b. Objectives to water quality in adjacent streams.

24. Ecologically sustainable development
   i. Statement of ESD policy reflecting NEAP, Fisheries Act, NADP, Natural Resources Act
   ii. Cultural sustainability
   iii. Social sustainability

25. Environmental management Plan
   i. Risk assessment
   ii. Emergency management plans
   iii. Monitoring areas and components \ monitoring requirements and
   iv. Recommendations regarding environmental audits

26. Conclusions and recommendations
   i. Based on study
   ii. Conformity with NEAP, SEA, NADP and ZEMA Act
   iii. Whether or not the project should proceed
   iv. Whether or not the project should be authorised

27. List of contributors
28. References
29. Appendices
8.0 Proposed Outline:

The Environmental Impact Assessment Report for the project shall include:

Executive Summary

1. Introduction
1.1 Country Profile and Global Overview of Fisheries
1.2 Project Background
1.3 Purpose of the EIA
1.4 Scope of the EIA

2.0 Legal and Institutional Framework
2.1 Environmental Management Act No. 12, 2011
2.2 Other Relevant Legislations

3.0 Project Rationale and Justification
3.1 Rationale
3.2 Justification and Importance of the Project

4.0 Alternatives to the Proposed Project
4.1 Without the Project
4.2 Land Based Earthen Ponds Aquaculture
4.3 Onshore Cage Aquaculture
4.4 Cage Culture without Nile Tilapia
4.5 Alternative location

5.0 Description of Project Components
5.1 Project Description
5.1.1 Offshore floating Cages
5.1.2 Onshore (Land Breeding Ponds and Fish Tanks)
5.1.3 Fish Processing Plant
5.1.4 Harbour
5.1.5 Fish Feed Plant
6.0 Description of the Bio-physical Environment
6.1 Bio-physical Environment
6.1.1 Aquatic Ecology
6.1.2 Water physical parameters
6.1.3 Water Chemistry
6.1.4 Fish community of the area
6.2 Terrestrial Ecology
6.2.1 Topography
6.2.2 Flora and Fauna
6.3 Socio-economic
6.3.1 Demographic Characteristics
6.3.2 Local Economic Activities
6.3.3 Existing Administrative structures
6.3.4 Land Tenure Systems
6.3.5 Land Use Systems
7.0 Environmental and Social Impacts
7.1 Bio-physical Environment
7.1.1 Aquatic Ecology
7.1.2 Water physical parameters
7.1.3 Water Chemistry
7.1.4 Fish community of the area
7.2 Terrestrial Ecology
7.2.1 Topography
7.2.2 Flora and Fauna
7.3 Socio-economic Environment
7.3.1 Demographic Characteristics
7.3.2 Local Economic Activities
7.3.3 Land Tenure Systems
7.3.4 Land Use Systems
8.0 Mitigation Measures
8.1 Bio-physical Environment
8.1.1 Aquatic Ecology
8.1.2 Water physical parameters
8.1.3 Water Chemistry
8.1.4 Fish community of the area
8.2.1 Terrestrial Ecology
8.2.2 Flora and Fauna
8.3.1 Socio-economic
8.3.2 Demographic Characteristics
8.3.3 Local Economic Activities
8.3.4 Land Tenure Systems
8.3.6 Land Use Systems
9.0 Environmental Management Plan (EMP)
9.1 Purpose of the EMP
9.2 Monitoring
9.3 Roles and Responsibility
10.0 Recommendations and Conclusion
11.0 References
12.0 Appendices
Appendix 1 List of Stakeholders Consulted During the Study
Appendix 2 Environmental Management Plan
Appendix 3 Terms of Reference for the EIA
Appendix 4 Checklist for Project Impact Determination
Appendix 5 C Vs for EIA consultants
Appendix 10: Curriculum Vitae of the Preparers of the Yalelo EIS

Team Leader: Choolwe G. Mudenda

1. Family name: Mudenda
2. First names: Choolwe, Gideon
3. Date of birth: 25th August, 1957
4. Passport Holder: Zambia
5. Residence: Lusaka, Zambia
6. Education:

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<tr>
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<td>Atlanta University 1989 - 1991</td>
<td>MA in Economics</td>
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<tr>
<td>University of Zambia 1975 - 1980</td>
<td>BA in Social Science (Development Studies major / Economics Minor)</td>
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7. Language skills: Indicate competence on a scale of 1 to 5 (1 - excellent; 5 - basic)

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<tr>
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9. Other skills: Advanced word processing, intermediate spread sheet skills, basic database computer programming and advanced econometrics and statistical computer analysis in SPSS, SAS and RATS;

10. Present position: Managing Consultant

11. Years within the firm: 10

12. Main qualifications Relevant to the project:

A) Development Planning

- Preparation of the National Aquaculture Development Plan of Zambia 2010-2014
- Preparation of the National Aquaculture Development Plan of Tanzania 2011-2015
- Preparation of Guidelines for the Fourth National Development Plan,
- Preparation of the Fourth National Development Plan of Zambia Agricultural Marketing and Cooperatives, Mining, Energy and Natural Resources and Tourism
- Preparation of the National Land Policy Document (2006),
- Preparation of the National Water Resources Master Plan Study 1993-1995
- Preparation of National Mining and Energy Annual Plans 1985-1994
• Preparation of the **Long-Term Electricity Master Plan** 1986

**B) Fisheries Production:**

• Preparation of the National Aquaculture Development Plan (Marine and Inland fish culture) for the Government of the Republic of Tanzania

• Preparation of a **Strategic Environmental Assessment Study** of Lake Kariba Siavonga for Development Fish Cage Culture. Zambia Aquaculture Farmers Project. GRZ/FAO Lusaka (2010)

• Baseline Study of Zambia Aquaculture Farmers Project. GRZ/FAO (2010):

• Preparation of the **National Aquaculture Development Plan of Zambia (NADP) 2010-2014**

• **Social and Environmental Impact Assessment of a 7,000 ton per annum Fish Cage Culture Project** in Kamimbi Village on Lake Kariba

• National **Biodiversity Strategy and Action Plan** GRZ/IUCN 19989

• Preparation of the **National Environmental Action Plan (NEAP) and Environmental Support Programme (ESP)** 1993-2008

• The **Economic Contribution of Fisheries in the Zambian Development** – Policy Paper 2008

• **Strategic Environmental Analysis of Fish Cage Culture Development Programme** on Lake Kariba

• **Aquaculture Environmental Conservation** Project 2010-11 and 2012

• Climate Change and Adaption Mitigation in Aquaculture and Fisheries Management: Policy Strategy Paper 2009

• **Economic Perspective of Aquaculture Development in Zambia**. (2006)

• **Aquaculture Business Templates** (2005)


• **Economics of Aquaculture in Zambia**, (2004)

• **Socio-economic Aspects of Aquaculture in Zambia** (2004)

13. **Key qualifications/competencies:** Has been involved in Zambian development planning since 1985; prepared a number of national development planning documents in Zambia and Tanzania. He is conversant with most important aspects of agricultural development initiatives, the critical issues facing aquaculture, crops, fisheries, livestock and silviculture – including apiculture. He is currently working as an independent researcher in aquaculture, environment and rural development, but has previously worked as an advisor and economist to the Government of the Republic of Zambia.

14. **Professional experience in the region:**

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<tr>
<th>Date from - Date to</th>
<th>Country</th>
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<tr>
<td>05/2-05/3/2011</td>
<td>Tanzania, NADP – Development Plan for Marine and Inland Aquaculture</td>
</tr>
<tr>
<td>2001 - 2002</td>
<td>East and Southern Africa, Researcher, Africa Resource Centre</td>
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<tr>
<td>1999 - 2001</td>
<td>South Africa and Portugal – EU North – South Centre</td>
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<tr>
<td>1994 - 1998</td>
<td>Zambia, UNDP National Long-term Perspective Study,</td>
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<td>1985 - 1994</td>
<td>Zambia, Development Planning Commission</td>
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<tr>
<td>1980 - 1984</td>
<td>Zambia, Tutor, University of Zambia</td>
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Aquatic Ecologist: Hangoma G. Mudenda

NAME: Hangoma Gordon MUDENDA

DATE OF BIRTH: 17/05/53

BIRTH PLACE: CHOMA (MACHA) / ZAMBIA

SEX: Male

PASSPORT NUMBER: ZN0 75268

ISSUED: 10/06/2009 IN LUSAKA

NATIONALITY: Zambian

LANGUAGES: English, Tonga (Mother tongue) and working knowledge of German and Nyanja

MARITAL STATUS: Married with two children

CONTACT ADDRESS: Department of Biological Sciences
University of Zambia
P. O. Box 32379

LUSAKA ZAMBIA

E-mail: hgmudenda@yahoo.com

2 PROFESSIONAL AND ACADEMIC QUALIFICATIONS

1989 MSc, Fish Population Dynamics (Mathematical option). University of Buckingham, England

1986 Postgraduate Diploma in Fisheries Biology and Management Norwegian Fisheries University, Institute of Fisheries Biology, Bergen, Norway.

1978 BSc, Biology/Chemistry and Education (with credit) University of Zambia.

3 WORKING EXPERIENCE

3.1 Employment Record

1998 Jan Lecturer in fisheries and freshwater biology in the Department of Biological Sciences of the University of Zambia (Present Position)

2004 May Dec Acting Head, Department of Biological Sciences, University of Zambia

1993 Sept Member of the National Environment Action Plan (NEAP) Planning and Technical Committee
1993 Feb  Chairman of the Fisheries Sub-Committees of the Agriculture Sector Investment Programme (ASIP)

1992-1998  Director Department of Fisheries

1992 July  Confirmed as Director of Fisheries: Zambia

1991 Feb  Appointed as Acting Director, Department of Fisheries

1990 - 1991  Deputy Director Department of Fisheries

1988  Project Co-Manager: Zambia/Zimbabwe SADCC Fisheries Project
1988-1989.1  Deputy Project Coordinator Zambia/Zimbabwe SADC Fisheries Project
1989  Chief Fisheries Officer, Head of the Fisheries Extension and Management Division of the Department of Fisheries

1987Jan-Aug  Acting Chief Fisheries Research Officer, Department of Fisheries

1986  Senior Fisheries Research Biologist, Department of Fisheries

1984  Limnologist and Head of Fisheries Research Programmes, Research Division

1978  Appointed Fisheries Research Biologist, Department of Fisheries, Zambia.

4.2 Major Consulting and Research Assignments Undertaken

2010 Jan  Consultant for the Zambia National Farmers Union: Assessing the Sustainability and Management of the Kapenta Fishery on Lake Kariba

2008/9 Nov  Consultant for the World Fish Centre Study for the Preparation of the Aquaculture Policy Document for Zambia

2009/11  Consultant, Ministry of Agriculture: Assessing the effect of aerial spraying on fish of the Kwando River: An Angola Zambia Project

2007Sept  Consultant, FAO for the preparation of the Fisheries Research and Management Project for Lake Tanganyika; The Fisheries Project for the Lake Tanganyika Commission

2006 Apr  Consultant, IUCN for the Zambezi Basin Wetlands Project and supervised fisheries surveys for the Upper Zambezi in Zambia and the Zambezi Delta in Mozambique

2006 Mar  Consultant Ministry of Environment and Natural Resources, NAPA UNDP funded project, Working on Fisheries and Climate Change

2006 Oct  Consultant for the World Bank SEED Funded Project Fish Stock Assessment for Lake Itezhi-tezhi and Main Rivers of the Kafue National Park

2005 July  Consultant, Ministry of Finance and National Planning for the preparation of the fisheries component of the Fifth National Development Plan
2005 June Team Leader for the SIDA funded Agriculture Support Programme (ASP) for the Study on Intensification and Commercialisation of Aquaculture in Zambia

2003 June Part of the Research Team from the School of Mines of the University of Zambia to assess the impact of sulphates in the Muntimpa Tailings Dam and Surrounding Environment

2002 Oct Consultants from the Department of Biological Sciences to take part in a study of the Zambia Wildlife Authority (ZAWA) for the Review of Existing Policy, Planning and Regulatory frameworks for the Management, Biodiversity Conservation and Economic Development in the Mosi oa Tunya and Kafue National Parks. Study supported by the World Bank. Responsible for Wildlife Policy and Institutional Arrangement

2002 Sep Consultant Senior Aquatic Ecologist Knight Piesold Consulting, Kafue River Basin Environmental Impact Study

2002 Mar Appointed as Chief Consultant by JICA. Preparation of the Fisheries Development Plan for the Ministry of Agriculture and Cooperatives

2000 Fisheries and Aquatic Ecology Expert in a Consulting Team from the Department of Biological Sciences of the University of Zambia assigned to prepare Wetlands Policies for Zambia

2000 Feb Principal Consultant in a Team from the Department of Biological Sciences of the University of Zambia Preparing EIA Guidelines for fish Farming. A Consultancy Assignment of the Environmental Council of Zambia


1999 Oct Fisheries Consultant for the World Commission on Large Dams: Lake Kariba case study: The study funded by the World Bank and IUCN

1998 May Fisheries Consultant for IUCN to undertake a study on the Biodiversity of fish in Zambia for the Zambia Biodiversity Strategy Action Plan (BSAP)

1998 Apr Fisheries Consultant for the FINNIDA funded Provincial Forestry Action Programme (PFAP) and assigned to assess Inter-linkages Between Fishing and Forestry in the Luapula Province.

1997 Nov Member of the quality assurance committee of IUCN. Supervising consultants conducting an environmental impact assessment for the Batoka Gorge Dam: Specific assignment involved a review of the sections on fish and fisheries

1996 Jun Consultant to the International Conservation Union (IUCN) Upper Zambezi Wetlands and Natural Resources Management Project
1995 Oct  Appointed to the National Steering Committee of the Agriculture Sector Investment Programme (ASIP)

1993 Dec  Appointed as Fisheries Consultant to National Environment Action Plan (NEAP)

1992 Sep  Worked as Consultant to the World Bank on Fisheries, September to October

1987     Worked with a consulting team from CIDA (May-June) involved in the preparation of a Fisheries Development Project for Bangweulu and Mweru-wa-ntipa Fisheries

5  RELEVANT PUBLICATIONS

2010     Sustainability and Management of the Kapenta Fishery on Lake Kariba. A Study report submitted to the Zambia national Farmers’ Union (ZNFU)


2007     Fisheries Management in Zambia with Reference to Lake Tanganyika. Study Report presented to the FAO workshop for the formulation of the Lake Tanganyika Fisheries Project

2007     Preliminary Surveys and Assessment of the Upper Zambezi Report. Study Report of the Institute for Policy Studies, Agriculture and Natural Resources Unit, Submitted to the World Conservation Union (IUCN)

2007     Fisheries Surveys of the Zambezi Delta Study Report of the Institute for Policy Studies, Agriculture and Natural Resources Unit, Submitted to the World Conservation Union (IUCN)


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<tr>
<th>Year</th>
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<tbody>
<tr>
<td>2000 Sep</td>
<td>Commercial Fish Farming in Zambia A Consultancy Report Prepared for the Food and Agriculture Organisation of the United Nations</td>
</tr>
<tr>
<td>1999 Nov</td>
<td>Fish and Fisheries Development in the Middle Zambezi. Consultancy report prepared for the World Commission on Large Dams</td>
</tr>
<tr>
<td>1998 April</td>
<td>Inter-linkages Between Forestry and Fishing in the Luapula Province. A Report Prepared for the FINNIDA Funded Provincial Forestry Programme (PFAP)</td>
</tr>
<tr>
<td>1996</td>
<td>Co Author of the Draft Fisheries Act of Zambia (Lay mans Draft)</td>
</tr>
<tr>
<td>1996</td>
<td>Options for Fisheries Management and Development in the Western Province of Zambia. A consultancy report prepared for the IUCN</td>
</tr>
<tr>
<td>1995</td>
<td>Co Author of the Fisheries Sub- Programme of the Agriculture Sector Investment Programme (ASIP).</td>
</tr>
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</table>


1989 The population of biology of the most abundant species of fish in Lake Kariba: Alestes imberi, Alestes lateralis, Hydrocynus forskahlii Tilapia rendalli Mormyrus longirostris Synodontis zambezensis and Limnothrissa miodon. A thesis submitted to the University of Buckingham for the degree of Master of Science in Fisheries Biology of the University of Buckingham.

1989 Zambia/Zimbabwe SADC Fisheries Project. Project Proposal as Co-Author

1987 An evaluation of the potential for fisheries development in the Zambezi West Bank. A special report prepared for the Department of Fisheries
1987 Co-author an Integrated Fisheries Development Project for Lake Mweru-wa-ntipa and Bangweulu Lakes and Swamps Complex. A report for CIDA


7. AREAS OF EXPERIENCE AND COMPETENCE
- Aquaculture
- Project identification, designing and implementation
- Fish Population Dynamics
- Fish Biology
- Limnology
- Aquatic Ecology
- Fishery Policy Formulation and Planning
- Fisheries Management and Administration
- Fish Taxonomy
- Statistics and Computing
- Fishery Law
- Government Administration

8. PROJECTS AND ASSIGNMENTS OF INTEREST
- Project identification and formulation
- Fisheries project monitoring and evaluation
- Preparing Aquaculture Projects
- Appraising fisheries and aquacultural projects
- Undertaking environmental impact assessments in the area of fisheries and hydrobiology
- Preparing fishery management plans
- preparing fishery management regulations
- Preparing Fisheries and Aquaculture Reviews
- Negotiating fisheries agreements with other countries and organisations
Administering and supervising rural development projects

10 CURRENT RESEARCH AND CONSULTANCY ASSIGNMENTS

i) Assessment of the economic feasibility of various aquaculture practices and systems

ii) Population biology of selected fish species in the following areas Mweru Luapula Fishery;

Bangwulu Fishery and Zambezi River System

iii) Preparation of the Fishery Policy Document for Zambia

iv) Biology of fish populations of the Kwando River

v) Biology of mouth brooding Tilapines of the Kafue River

vi) Population biology of Brycinus lateralis in the Kafue River system

GIS Specialist: Anastasia Banda

Date of Birth: 03/09/1966,

N.R.C 111659/14/1, Zambian National

Profession GIS/REMOTE SENSING SPECIALIST

Education: Grade 12 School Certificate

Other Qualifications:


ii. Certificate in Cartographic-Reprography Techniques (Ordnance Survey, (Britain Jan-April 1990)


Training

i. Certificate in Leica Photogrammetric Suite (LPS) workflow (Regional Centre mapping Resources for Development July 2010)

ii. Certificate in Erdas Imagine workflow (June 2010 Lusaka)

iii. Certificate in Leica Photogrammetric Suite and Stereo Analyst for ARCGIS (Nov 2008)

iv. Certificate in Photogrammetric Spatial Data Acquisition within the Scope of GIS and Internet Mapping (Nov 2006 University of Zambia)

v. Certificate in ARCGIS 1, 2 and Building a Base map using PLTs 3.1 (Sept 2003 Kenya)

vi. Certificate in Water Balance Applications and Integration with Remote Sensing and GIS (Jan 2003, University of Zambia/University of Kansas)

vii. Certificate in Remote Sensing application and Visualization in GIS (June 2002 University of Zambia/University of Kansas)

viii. Certificate in Desk-Top Cartography (Nov-Dec 1998 University of Zambia)

ix. Certificate in Customer/Human relations (August 2001)

Consultancies

• Training in ARCGIS with Water Dept (2006)
• Plan international Zambia: Geo-Databases on Water points in their working Areas in 4 Districts
• Formulation of an integrated Development Plan for Lumwana and New Solwezi town. (2006-2010)
• Preparation of the Greater Livingstone Tourism Area Action Plan

**Employment Record**

**1989 to date:** Survey Department, Mapping Room - Aerial photos or Satellite imagery Interpretation.

**Skills:** Techniques of primary data acquisition using ArcView, ArcGIS, Erdas Imagine, Global Mapper. ER Mapper in Windows NT environment and updating of maps using Global Positioning System collected point.