PROMOTING ENVIRONMENTALLY SUSTAINABLE COMMERCIAL AQUACULTURE PROJECT IN UGANDA

Financial Agreement no. UG/FED/2016/038-334

CONSTRUCTION OF MWENA AQUAPARK INFRASTRUCTURE

TECHNICAL SPECIFICATIONS

AUGUST 2019

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1 EMPLOYER'S REQUIREMENTS

1.1 Project purpose

1.1.1 General objective

This document contains outline design, and particular conditions for the project **"Promoting Environmentally Sustainable Commercial Aquaculture Project in Uganda"** The general objective of the project as stated in the Financing Agreement between Government of Uganda and the EU Delegation is to contribute to a competitive, job-intensive, environmentally sustainable and climate resilient agricultural sector in Uganda.

Under this project, a water based, cage-tilapia Aquapark will be constructed in Mwena Bay in Kalangala District. The aquapark will be operated under a PPP arrangement between the Government of Uganda and technical operators focused on increasing production and demonstrating production techniques that are modern and have professional management. The purpose will be to stimulate further interest in commercial fish farming at scale within the community, and more widely in the country

1.1.2 Specific objective

The **specific objective of the project** is to support the development of a competitive, job-intensive, environmentally-sustainable and climate-resilient aquaculture value chain in a comprehensive manner.

1.1.3 Project results

Result 1: The policy and regulatory frameworks affecting the operations of the commercial aquaculture industry improved and implemented;

Result 2: production and productivity of aquaculture fish and fish products enhanced, giving priority to locally-developed practices and focusing on smallholder and rural livelihoods and formation of producer groups;

Result 3: post-harvest handling and marketing of aquaculture fish and fish products improved. The programme will have a strong focus on smallholders.

The Ministry through PMU decided to undertake Design and Build mode of implementation of the projects in order to save time. Consultants were contracted to prepare tender dossiers for the identification of a suitable Design and Build Contractor who will prepare detailed engineering designs and cost estimates for construction works in Mwena, and subsequently undertake construction. It is envisaged that the supervision consultant will be a firm with requisite experience and resourcing (technical, HR and financial) to undertake the assignment.

This construction project directly contributes to **Result 2.** Background studies and consultation resulted in the identification of two sites for aquaculture park development under the project: a land-based one in Apac district and water-based one in Kalangala district. Studies have been undertaken to determine the suitability and feasibility of the sites for the intended purposes as part of the overall process required to develop the aquaculture parks.

1.2 Project scope

A fish landing site and processing facility developed in 2004 by the African Development Bank will be the base of the aquapark shore operations because it is already equipped in terms of infrastructure and only requires additional development to make it fully functional. Current facilities on the site include:

1. Concrete jetty
2. Post-harvest fish handling shed (for sorting and washing)
3. Drying platform
4. Ice plant (5mt capacity) and two ice storage rooms
5. Pump house, pumps, and chlorine dozing unit
6. Reservoir
7. Office block
8. Pit latrines
9. Lavatories
10. Concrete garbage bin
11. Staff canteen
12. Drive way for light-truck access
13. Paved parking lot

The site is fenced with three gates which access the jetty, pump house and main site entrance.

1.2.1 Proposed renovations and new developments-on shore

Technical assessment of the infrastructure completed in 2019 by a staff from MAAIF DAIMWAP and DAMD concluded that most of the facilities are in good condition, but would require upgrade and renovation. A new hatchery site is also located nearby on a 22-acre land piece. Additional on-shore buildings facilities and works required to support aquaculture operations of the Aquapark include

1. Feed store
2. Net washing platform and net inspection area
3. Workshop
4. Fuel store
5. Ice Plant
6. Back-up power supply
7. Training room
8. A hatchery
9. Floating jetty
10. Drainage works
11. Waste treatment and disposal
12. Improved road access

At full operation, the site is projected to produce 21,000mt of tilapia annually

1.2.2 Off-shore facilities and works

Cages will be located at approved sites which have minimum interference with other lake uses and with suitable conditions for fish growth. Minimum distances of cage sites from other lake uses and neighbourhood will be;

a) 100m from navigation routes,
b) 100m from protected areas (for this case, natural forests),
c) 500m from recreational facilities,
d) 200m from landing sites as well as from fish breeding and nursery areas,
e) 500m from water extraction/abstraction points,
f) 500m from effluent discharge and waste disposal points, and

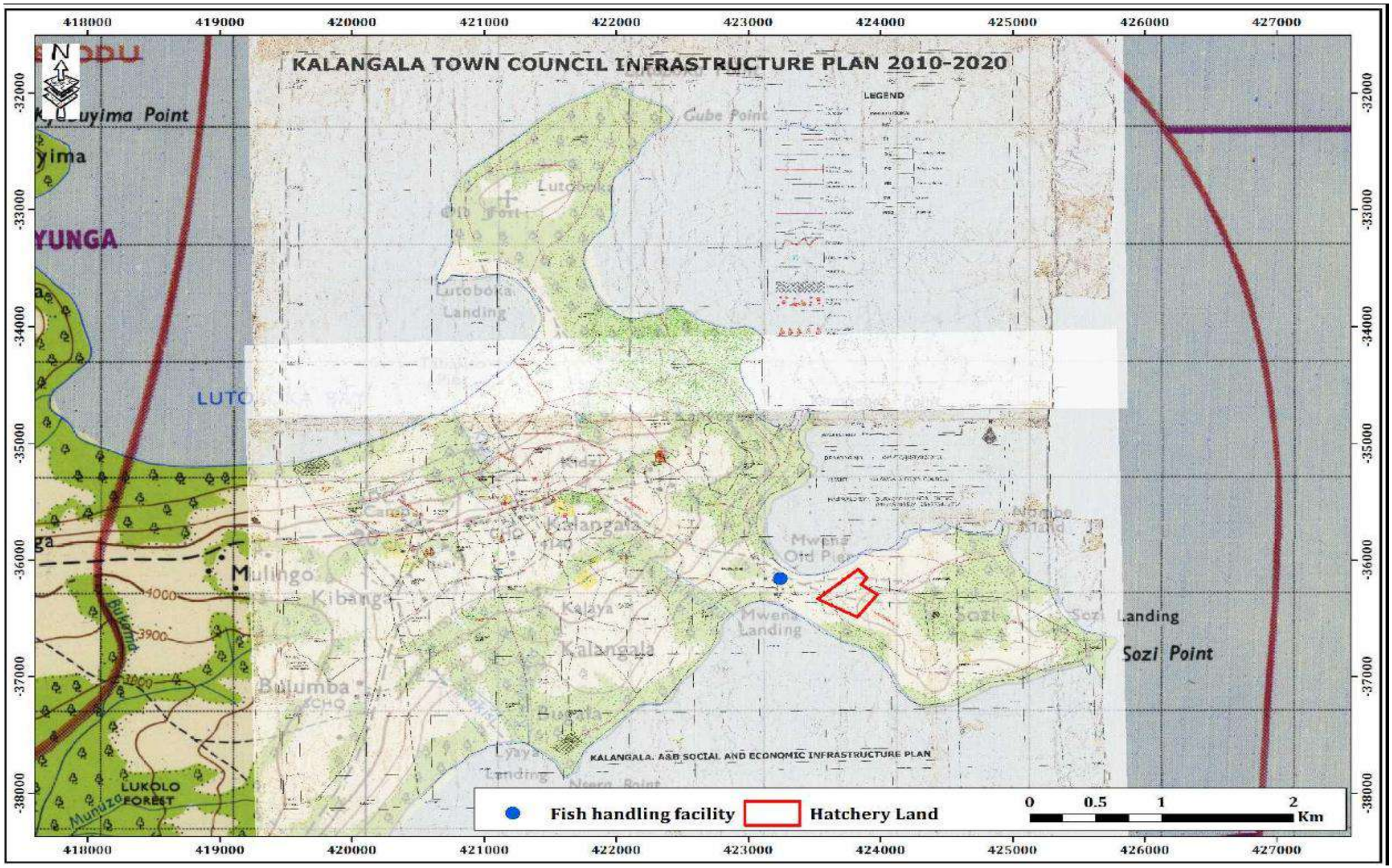
g) 100m from weed hotspots;

There should be sufficient water column depth, to allow wastes and left-over food to settle and decompose at safe distance without causing competition for oxygen between the cultured fish and the de-composition bacteria. The water column also serves as a guard against disease transfer from the decomposing substances to the fish. A cage depth to water column depth ratio of 1:3 should be maintained by the Contractor.

A water current flow rate of 1-6m/minute will be required to effectively wash fish wastes and un-eaten food through and out of the cages at a rate such as to constantly maintain the optimum water quality balance for best production results. A consistent supply of naturally occurring dissolved oxygen at such concentration levels as to support the high fish densities that are characteristic of cage culture should be maintained. A relatively low micro-organism population, to a secchi disc reading of between 80–200cm, as this will ensure a biomass balance in favour of the cage farming activities, when keeping environmental impact in check; alkalinity and hardness necessary to keep the water pH within safe range for fish life sustainability.

1.3 Outline design consideration

This outline design of the proposed renovations and new developments will be the starting point for the design and build contractor. This design must be reviewed together with the feasibility study and technical assessment reports prepared to determine the site suitability and accompanying conditions.


KALANGALA TOWN COUNCIL INFRASTRUCTURE PLAN 2010-2020
LEGEND
KALANGALA. A&B SOCIAL AND ECONOMIC INFRASTRUCTURE PLAN
Fish handling facility
Hatchery Land
0 0.5 1 2 Km
418000 419000 420000 421000 422000 423000 424000 425000 426000 427000
-32000 -33000 -34000 -35000 -36000 -37000 -38000
Gube Point
Lutobola Landing
Kalangala
Mwena Old Pier
Mwena Landing
Sozi Landing
Sozi Point
Bulumba
Kibanga
Kalaya
Mulingo
LUKOLO FOREST
Muruzo
Bukamba
4000
3900
3800

2 OUTLINE DESIGN

The components of the aquapark infrastructure are as follows: -

2.1 Site of the cage culture

2.1.1 Water Quality

During construction and after completion, the water quality should be maintained in the following ranges

a) **Dissolved Oxygen (DO):** levels of the site must be maintained in the range between 6.10± 1.20mg/l and 7.50±0.84mg/l. Acceptable minimum is of 4mg/l and 3mg/l.

b) **pH**: The pH in the different bays must be maintained in the range between 6.80±1.40 and 8.90±0.40

c) **Conductivity**: acceptable range is 30 – 3000µs/cm.

d) **Temperature:** The measured temperature at all the different sampled points within these bays were also within the acceptable range for aquaculture of 24 – 32˚C

e) **Ammonium –Nitrogen (NH_4-N):** acceptable level is less than 0.5mg/l

f) **Soluble Reactive Phosphorous (SRP):** The acceptable range of less than 70mg/l

2.1.2 Total depth

Small to medium holder cages of maximum depth not exceeding 3m are more preferred in the surveyed sites whose depth was found to be less than 6m. These can be cages of 5 X5 X 3m operated at a Low Volume High Density (LVHD) principle. The relatively shallow, well sheltered areas are good for the small and medium cages since such areas do not experiences the strong winds and waves.

2.1.3 Water flow rates

The average measured water flow rates in all the sampled points were found to be on the lower side of the acceptable ranges for cage Aquaculture of 10–100cm/sec. Low stocking densities should deploy in areas whose flow rates are less than 50cm/sec so that environmental sustainability is to be ensured.

2.2 Netting

The most commonly used netting material is flexible nylon since it is relatively inexpensive and it can be treated with chemicals against anti-fouling. Rigid netting material (e.g., rigid plastic, galvanized or plastic-coated steel) are also used in some cases.

The mesh size should be as large as possible, taking into account the fish size. The larger the mesh size the better the oxygen supply of the stocks and the fouling problems are less as well. The fouling of the net should be avoided by regular cleaning or by replacing it. Heavy fouling reduces the water exchange through the net wall and thus causes oxygen depletion inside the cage; increases the net drag requiring large and more expensive mooring; increases labour requirement in cleaning and replacing the net.

2.3 Floating jetty

The Contractor shall supply and install a modular floating jetty for exclusive use for feeding operations.

2.4 Shore facilities

2.4.1 Intake works and Pump Houses

The Contractor shall upgrade the existing pump house as follows:

a) Change the intake and pumping main pipe to 4-inch diameter, and extend it 1km from current suction point

b) Install salt electrolyte dozatron system for disinfection

c) Repair pump hose, fence and gate.

d) Change transmission main to four-inch pipe diameter

Drawing is attached.

2.4.2 Toilets

The Contractor shall construct additional toilet facilities for both men and women (drawing attached).

2.4.3 Flake Ice plant

The Contractor shall construct a flake ice plant. Flake ice will be stored in silo or bin with the ice-maker located over the store. The silo will be contained within an insulated jacket and cooled air passed between the jacket and silo to keep the ice in a subcooled and dry condition. A trap door will be provided in the top of the silo for access. The trap door will be connected to a safety mechanism that isolates the agitator mechanism. Ice requirements will be 70t per week.

The Contractor shall install a mechanical rake and end gate system for handling and discharge operating on the first in-last out principle. To manage emptying and stale removal stale and packed ice build-up at the bottom, a double bin system shall be installed

2.4.4 Access road

The existing width of the road carriageway of the and Mweena-Sozi road shall be increased to at least 7m carriageway respectively with 1m gravel shoulders and drainages on the approach to the fish processing facility site to allow for trucks delivering feed to access the site, without disrupting traffic of trucks transporting processed fish. This might require community engagement to clear the right of way.

2.4.5 Feed store, office and training room

The Contractor shall construct a dry feed store with 500mt capacity at any given time should be constructed. Feed will be delivered on site by 40ft container trucks. There must be access by road, and sufficient turning room and space to off-load. The feed store should have large doors to facilitate circulation of people carrying sacks, pallet movers etc. The store should be of metal frame design and have high roofing clearance and a concrete floor with a 1% slope, sufficient lighting, ventilation including air extraction and pest proof. Floor areas of the feed store will be 318.75 m^2 mezzanine floor is included to provide for office space, and training room for farmers etc. Dimensions of the feedstore are calculated based on the footprint of a feed bag, how many can be packed in 1 layer, and the number of layers on top of each other in the building. Details are presented in the Table below.

Table 1 Computations to determine feedstore dimensions

Feed bag dimension		
Bag length	0.65	m
Bag width	0.45	m
Bag thickness	0.13	m
Bag area	0.29	m^2

Feeding requirements	3,374	Tonnes feeding/year
	281	Tonnes feeding/month
	9.4	Tonnes feeding /day

Calculation of feed store requirements		
Feed store length	25	m
Feed store width	15	m
Area of feed store at 85% use	318.75	m^2

Number of bags per layer	1090	Bags

Number of layers	20	Layers
Estimated height of stack	2.6	m
Total stock capacity	545	Tonnes stock
Corresponding daily feeding capacity	14.1	Tonnes Feeding/day
Corresponding number of days stock	38.8	Days stock

2.5 Net washing platform and net inspection area

The Contractor shall improve the current platform initially planned to be used for drying fish is retrofitted as the net washing platform. The slab will have to be smooth concrete with 1% slope starting from the centre and going to the drains at the edges, for water evacuation. Drains are required all around the platform to collect water and to channel it towards a collection/ discharge point. The platform should be roofed to protect nets from UV light. The location of the drainage infrastructure will be determined at design stage of the design and build project.

2.6 Net store

The Contractor shall construct net store should have a floor area of approximately 280M$^{2.}$ Nets will be sorted individually after being washed, dried and inspected. Nets will be delivered to the store by a small truck and be discharged by hand. The net store shall have large opening doors to facilitate circulation of people easy access by a small truck and eventually the circulation of a forklift truck. The store shall be water proof, have a concrete floor with a 1% slope, sufficient lighting, ventilation including air extraction and pest proof.

2.7 Equipment, changing and weather rooms

The Contractor shall construct a workshop facility should have a minimum area 250m^2 to store outboard engines, needing service or repair, as well as any other equipment needing maintenance. Wall partitions, electrical distribution boards and drains should be specified in the design. Lighting and ventilation to meet standards should also be constructed. The Contractor shall construct a changing and weather rooms adjacent to the equipment room (drawing attached).

2.8 Back-up power supply

The Contractor shall construct a concrete platform onto which a back up diesel generator of adequate capacity shall be installed to supplement mains supply.

2.9 Fuel tank

The Contractor shall supply and install a fuel tank of adequate capacity to provide fuel for operations and back-up power supply generator.

2.10 Hatchery

Hatchery: A land-based breeding and hatchery will produce fingerlings on a weekly basis synchronized with the lake nursery and grow-out production plan. The brood stock will be reared in ponds, eggs collected and artificially incubated, and larvae reared in ponds until they reach 2 grams.

Lake nursery: fish will be transferred from the hatchery at approximately 2 grams and stocked in the nursery cases for a period of 60 days, and then transferred to the grow-out cages when they attain 20 grams weight.

Grow out: juvenile fish will then be transferred into grow-out cages for 200 days until they reach harvest size of 420grams.

2.11 Cage design and specifications

Cage designs are proposed based on industry standards for commercial intensive tilapia cage culture which have proved to be technically and financially viable in similar context, within Uganda and in other African countries (Ghana, Kenya, Zimbabwe, Zambia).

2.11.1 Nursery production

Cage sizing for nursery production by three operator types is presented in the Table below

Table 2 : Computations to determine nursery cage numbers for different operators

	Unit	Small grower	Medium grower	Large grower
Cage type	m	Metal square	HDPE square	HDPE square
Cage size	m^2	6m X 6m	6m X 6m	6m X 6m
Depth	m	3	6	6
Volume	m^3	108	216	216
Final density	Kg/m^3	4.5	3.5	5.0
Transfer weight	g	20	20	20
Growth	g/day	0.3	0.3	0.3
Stocking weight	g	2.0	2.0	2.0
Culture period	Days	60	60	60
	Weeks	8.6	8.6	8.6
	Month	2.0	2.0	2.0
Maintenance days	Days	3	6	6
Final Fish Nº/cage	Pcs	21,600	34,560	48,600
Nursey survival		80%	80%	80%
Initial Fish Nº/cage	Pcs	27,000	43,200	60,750
Initial Fish Nº/batch	Pcs	27,000	21,916	122,338
No. of Crops/cage		5.8	5.5	5.5
Cages needed / batch		0.8	0.5	2.0
No. of batches/ year		1.4	2.2	0.5
Total juvenile cages needed		**2**	**4**	**16**

Grow-out production for different operators is computed in Table 3 below.

Table 3 Computations to determine grow out cage sizes for different operators

	Unit	Small grower	Medium grower	Large grower
Cage type	m	Metal square	HDPE square	HDPE round
Cage size	m	6m X 6m	6m X 6m	16m diameter
Depth	m	6	6	6
Volume	m^3	216	216	1206
Number of cages		**8**	**24**	**24**
Final density	Kg/m^3	30	30	30
Harvest weight	g	420	420	420
Growth	g/day	2.2	2.2	2.2
Stocking weight	g	20	20	20
Culture period	Days	182	182	182
	Weeks	29	29	29
	Month	6.7	6.7	6.7
Maintenance days	Days	0	0	0
No. of Crops/cage		2.0	2.0	2.0
No. of batches/ year		16.1	48.2	48.2
Survival	%	88	88	88
Fish harvested/cage	Pcs	15,429	15,429	86,126
Fish stocked/cage	Pcs	17,532	17,532	97,870

	Unit	Small grower	Medium grower	Large grower
Production per cage per crop	Kgs	6,480	6,480	36,173
Total annual tilapia production	Kgs	104,069	312,206	1,742,806
	Tonnes	104	312	1,743

2.12 Cage specifications for large-scale operator

2.12.1 Nursery cages

Table 4 Nursery cage specifications for large scale operator

Cage specifications	Floating HDPE cages, 6m X6m frames with handrail
Cage quantity	18
Equipment	Square HDPE floating cages with handrails Production net 6m depth Predator net 6.5m depth Bird net Sinkers Mooring system: anchors, chains, ropes, buoys, walkways Galvanized pipe 7mling for net bagging Husbandry equipment
Considerations	Nursery cages to be organized in clusters to facilitate husbandry

2.12.2 Grow-out cages

Table 5 Grow-out cage specifications for large scale operator

Cage specifications	Floating HDPE cages, 16m diameter, 6m depth
Cage quantity	24
Equipment	Circular HDPE floating cages Production net 6m depth Predator net 7m depth Bird net Sinkers Mooring system: anchors, chains, ropes, buoys, walkways Siene nets for harvest Husbandry equipment
Considerations	

2.12.3 Equipment and infrastructure

Lake platform

Table 6 Lake platform specification for large scale operator

Platform specifications	Floating platform, deck area of approximately $50m^2$
Equipment	Circular HDPE floating cages Production net 6m depth Predator net 7m depth Bird net Sinkers Mooring system: anchors, chains, ropes, buoys, walkways Siene nets for harvest Husbandry equipment
Considerations	

Harvest vessel

Table 7 Harvest vessel specification for large scale operator

Specifications	Boat with large flat deck to load and un load fish crates
Equipment	Barge Crane
Considerations	

2.13 Cage specifications for medium-scale operator

2.13.1 Nursery cages

Table 8 Nursery cage specifications for medium-scale operator

Cage specifications	Floating HDPE cages, 6m X 6m frames with handrail
Cage quantity	4
Equipment	Square HDPE floating cages with handrails Production net 6m depth Predator net 6.5m depth Bird net Sinkers Mooring system: anchors, chains, ropes, buoys, walkways Galvanized pipe 7mling for net bagging Husbandry equipment
Considerations	Nursery cages to be organized in clusters to facilitate husbandry

2.13.2 Grow-out cages

Table 9 Grow-out cage specifications for medium scale operator

Cage specifications	Floating HDPE cages, 6m X6m frames with handrail
Cage quantity	24
Equipment	Square HDPE floating cages with handrails Production net 6m depth Predator net 6.5m depth Bird net Sinkers Mooring system: anchors, chains, ropes, buoys, walkways Galvanized pipe 7mling for net bagging Husbandry equipment
Considerations	Nursery cages to be organized in grid with spacing to facilitate water exchange

2.13.3 Equipment and infrastructure

Two boats to facilitate daily operations

2.14 Cage design for small-scale operator

2.14.1 Nursery cages

Table 10 Nursery cage specifications for small-scale operator

Cage specifications	Floating metal cages, 6m X 6m frames with handrail
Cage quantity	2
Equipment	Square HDPE floating cages with handrails Production net 6m depth Predator net 6.5m depth Bird net Sinkers Mooring system: anchors, chains, ropes, buoys, walkways Galvanized pipe 7mling for net bagging Husbandry equipment
Considerations	Nursery cages to be organized in clusters to facilitate husbandry

2.14.2 Grow-out cages

Table 11 Grow-out cage specifications for small scale operator

Cage specifications	Floating HDPE cages, 6m X6m frames with handrail
Cage quantity	8
Equipment	Square HDPE floating cages with handrails Production net 6m depth Predator net 6.5m depth Bird net Sinkers Mooring system: anchors, chains, ropes, buoys, walkways Galvanized pipe 7mling for net bagging Husbandry equipment
Considerations	Nursery cages to be organized in grid with spacing to facilitate water exchange and husbandry

2.14.3 Equipment and infrastructure

One boat to facilitate daily operations

3 PARTICULAR SPECIFICATIONS

3.1 Engineer's estimate

	Description	Unit	Quantity	Rate US$	Amount US$
1	Off shore infrastructure				
	Cage infrastructure				
	Nursery 6mX6m HDPE Cages	Cage	56	3,600	201,600
	Grow out 16m diam. circular cages	Cage	24	4,100	98,400
	Floating platform				
	Floating platform 50m^2	nr	1	108,996	108,996
	Intake works and pumping station				
	Surface water pump	per pump	2	6,000	12,000
	Intake works	lumpsum	2	33,113	66,225
	Transmission and reticulation system	km	6	13,797	82,781
	Renovation works to pump house	lumpsum	1	13,797	13,797
2	On-shore infrastructure				
	Feedstore, office and training room				
	Feedstore, office and training room	m^2	378	450	170,100
	Ice plant				
	Flake ice plant	Lumpsum	1	34,500	34,500
	Incinerator				
	Incinerator	nr	1	1,518	1,518
	Toilet block	nr	6	690	4,139
	Changing room, equipment room and weather room				
	Changing room, equipment room and weather room	m2	45	414	18,630
	Assorted equipment	lumpsum	1	27,594	27,594
	Drainage improvements				
	Builder's work	Lumpsum	1	41,392	41,392
	Hatchery and training centre				
	Hatchery and training centre	m2	375	470	176,250
	Hatchery sets	nr	2	48,289	96,578
	Treatment works	nr	1	1,932	1,932
	Net inspection area (roofing)				
	Roof structure	m2	175	140	24,500
	Earthworks				
	Pond construction	ha	3	1,656	4,139
	Road improvements	km	7	9,658	67,605
	Backup power supply				
	Diesel generator and fuel tank	nr	1	34,492	34,492
3	Preliminaries				
	Plans and permits				
	Plans and permits	lumpsum	1	13,797	13,797
	Provisional sums (including capacity development)				
	Counterpart training	lumpsum	1	44,150	44,150
	Insurance				
	Insurance	lumpsum	1	8,278	8,278
	Sub-total				1,353,393
4	Contingency				
	10% contingency				
	Contingency	% of total	10		135,339
	Grand total				**1,488,733**

3.2 Engineer's drawings and calculations

1. The D&B contractor shall submit to the Engineer in triplicate the following drawings as supplements to the final design:

- contract drawings, wiring diagram and construction plans and drawings, installation plans, complete cable lists, clamping plans, as well as lists of part, clearly indicating material and type of proposed equipment.
- works and general layout drawings providing the Engineer with the details of all properties that may be destroyed in the course of the execution of works, four weeks prior to commencing works in the affected area
- as-constructed drawing; with actual (not typical) section drawings where applicable.

2. In general, engineering calculations with comprehensive sketches, with importance being to the completeness and clearness of presentation shall constitute the supporting documentation for this process. Design calculations including for any assumptions made shall be referenced against the latest applicable building code(s). Such calculations, shall be submitted to the Engineer forty-eight (48) hours before construction of the design element commences for his concurrence.

3. Within a period of three (3) weeks following the issue of the 'Take-over' certificate the as-built drawings shall be submitted. One set shall be reproducible on plastic (or equivalent) and three sets shall be ordinary prints.

3.3 Earthworks

4. The dams under construction shall be of the 'Very Low' to 'Low' hazard category; for dimensioning purposes the height of the dam shall be less than 3.0m whereas retained volume of water shall be less than 3 million cubic metres.

5. The proposed sites for dam construction shall be investigated to establish the nature of foundation and to locate sufficient suitable clay material to use in the embankment.

6. The D&B contractor shall in the submitted rates allow for excavating the site to the extent of formation level possible. The ordinary excavated material and topsoil being reserved for filling within the site, landscaping and the balance disposed of.

7. Top soil shall be placed in layers not exceeding 200mm shall be located in areas outside of the area to be covered by the embankment and planted with grass.

8. The base of the embankment (foundation) shall be stripped of all topsoil, silt, loose material, vegetable matter, and then scarified over its whole area.

9. No attempt shall be made to excavate into rock; with all exposed such areas be it gravel, jointed rock or other impervious material in the storage area and under the embankment covered with 300mm of compacted clay or use bentonite and a mortar or shotcrete blanket over the exposed surface to ensure water tightness.

10. A cut-off trench (keyway) which shall be 1.5 times the height of the dam at the bottom of the trench; minimum of 600mm down into impervious soil or rock; and extended the length of the embankment minus length under spillway's cut into rock. Backfilled with the appropriate quality of clay, thoroughly compacted.

11. Compaction requirements:

- all fill material for the embankment shall be placed in layers of no greater than 150mm thick.
- before each additional 150mm layer is added to the embankment, the preceding layer should be scarified to ensure proper joining.
- the largest particle size to be used in the embankment shall be no greater than 38mm.
- minimum compaction effort shall be 95% standard MDD
- range of compaction effort shall be kept at a minimum throughout the dam to avoid differential settlements.
- to ensure proper compaction, the optimum moisture content (OMC) shall be in the range of -1% to +3%.

12. Spillway requirement:

- minimum width shall be 3m.
- amount of freeboard shall cater for specified flood flows.
- spillway shall preferably be cut in solid material (rock).
- absolute minimum for the freeboard is 500mm, with an additional 250mm to cater for potential wave action.

13. Anchor block designs, shall be based on the following conditions:

    - dry soil density: 1800 kg/m3
    - submerged soil density: 1090 kg/m3
    - angle of internal friction: 30 deg.
    - passive resistance factor: 3

    Upstream end of every outlet pipe shall be fitted with screen and downstream end with stop tap and marker. Screen and pipe inlet shall be encased in concrete anchor block. Where considerably better ground conditions, such as rock, are encountered, the dimensions of anchor block shall be reduced.

14. The full excavation for embankment material, wherever possible shall be kept below the full supply level (FSL) of the storage areas.

15. Great care shall be taken when obtaining borrow materials from steep bank areas prone to instability. For excavations deeper than the chest level where it is intended that a person will enter: appropriate material, such as steel, shall be used for shoring; or all sides of the excavation shall be battered back at slopes not greater than 2:1 horizontal to vertical.

3.4 Pipe work

16. Pipework shall conform to the following quality criteria:

    - specific weight: 1.40 g/cm3.
    - tensile strength: > 50 N/mm2
    - coefficient of thermal expansion: 80E-6/K
    - modulus of elasticity: 3000 N/mm2
    - thermal conductivity: 0.15 W/m. K
    - chemical resistance: acc. DIN 16929
    - impact strength: acc. to DIN 8061
    - hydraulic roughness < 0.1mm

17. Outlet pipe materials and installation:

    - high density polyethylene (HDPE) preferred pipework material.
    - use Uganda Standard, US 482: 2002 Polyethylene (PE) pipes
    - pressure applications NOT less than a PN 10 rating.
    - pipes shall be joined by fusion welding or victaulic joints or depending on the application a mixture of both.

3.5 Testing

18. All items shall be duly factory-tested prior to delivery according to established Uganda Standard or any other such similar test. All items shall be duly marked as follows:

    - Nominal diameter
    - Nominal pressure
    - Material of the body
    - Manufacturer's trade mark
    - Maximum temperature of fluid
    - Permissible working pressure
    - Quality control mark
    - Serial number
    - Year of manufacture
    - Stamp of acceptance
    - Hydraulic coefficients
    - Number of standard

19. Filling of the dam shall proceed only after a Work-as-Executed (WAE) report has been submitted to the supervising Engineer. The dam shall be filled as slowly as possible, preferably not more than 0.3 metres depth per day to let the new embankment adjust to the increasing water loads.

20. Testing will be required in the following two categories: work tests as part of inspection; and tests on completion comprising tests on completed sub systems and 30-day operation tests.

3.6 Other standards

The following is a list of acceptable standards and codes which shall also be adopted by the Contractor in the design and execution of the works:

- US CAC/RCP 52:2003, Code of practice for fish and fishery products
- US EAS 832:2015, Fish industry – Operational cleanliness and hygiene – Guidelines
- US EAS 62-1:2017, Fish handling and processing — Code of practice — Part 1: Fresh fish
- . US 129:1999 Code of Practice for the handling, processing, storage, and placing on the market of fish and fishery products
- US 130: 2017, Hazard Analysis Critical Control Point (HACCP) based Food Safety Systems — Requirements (2nd Edition)
- US 131:1999 Fish and fishery products – Determination of the concentration of Total Volatile Basic Nitrogen (TVBN)
- US 814:2009, Fish feeds — Specification
- US EAS 827:2015, Fresh and frozen whole fin fish – Specification
- US EAS 829:2015, Transport of live fish seeds for aquaculture purposes – Code of practice
- US EAS 833:2015, Processing and handling of dried fish and fish products – Code of practice
- US EAS 876:2017, Smoked fish, smoke-flavoured fish and smoke-dried fish — Specification
- Appropriate **Engineering and Management Services Standards** as prepared and recommended by the Uganda National Bureau of Standards.

The Client may accept other comparable codes and standards provided that they are widely accepted internationally.

3.7 Office and accommodation for owner's engineer

All equipment and furnishings detailed under this Clause shall be provided by the Contractor under item for Resident Engineer's offices under Bill No. 1. All the equipment and furnishings will revert to the Authority (client) at the end of the Contract. The Authority/Client shall provide prefab unit as the office of the resident engineer/monitor for the site and the contractor is responsible for its erection.

The Contractor shall arrange for the provision of telephones/mobile (and if necessary, extensions) with suitable privacy for conversation for the exclusive use of the Resident Engineer and his staff. The Contractor shall include in the sum for provision of the office equipment and furnishings for the charges for installation, maintenance and removal of the telephones. All charges for hiring and telephone calls shall be under the relevant item in Bill No. 1. Provision shall also be made by the Contractor for all necessary gas, electricity, kerosene, water, light, attendance and stationery required in connection with execution of the Contract.

Furniture	
Writing Desk with 3 lockable drawers	3 Nr
Metal Chairs with arm rests	3 Nr
Wooden Conference Table, 2.5m x 1.5m	1 Nr
Metal office chairs without arm rests	6 Nr
Lockable Steel Cupboard (Size 1m x 1.8m x 0.5m deep)	1 Nr
Office paper punch	1 Nr
Whiteboard, 2.4m x 1.2m	1 Nr
Whiteboard, 1.2m x 1.2m	1 Nr
Office Tray (3 tier)	1 Nr

Furniture	
Office Stapling Machines	1 Nr
Steel File Cabinet with locks / 4 drawers ('Mecol' or equivalent approved)	1 Nr
'Casio' or similar small portable scientific electronic calculator	1 Nr
'Casio' or similar small portable electronic calculator	1 Nr
First Aid kit (for 10 persons) in Metal Box	1 Nr
Potable Fire Extinguisher (5 litres)	2 Nr
Small office scissors	2 Nr
Waste paper baskets	4 Nr
Electric kettle (capacity to make 12 cups of tea)	1 Nr
Coffee/Tea making facility including crockery for all supervisory staff 6 Nr. and 12 additional guests	1 Nr
Pedestal electric fan, size 400mm	1 Nr
'Sanyo' or equivalent approved Refrigerator (0.2 cu.m. capacity)	1 Nr
Lenovo P50 or advanced	1 Nr
Lenovo P50 or above	1 Nr
HP LaserJet Printer A4	1 Nr
HP Colour Inkjet Printer A3	1 Nr
Photocopier - Nashua or approved equivalent, A3, 18 pages per minute	1 Nr
Petty Cash Box with security lock	1 Nr
Wall Clock	1 Nr
Flashlights (battery powered)	1 Nr
Digital Camera as specified	1 Nr

Stationery	
Masking tape (medium)	1 Nr
Staples	2 Pac.
Paper clips (various sizes)	2 Pac.
C-DR (Pack of 12)	1 Pac.
CD-RW (Pack of 12)	1 Pac.
Highlighters (set of all colours)	2 Sets
A6 hardcover notebooks	2 Nr
Soft Pencil Erasers (Staedtler or equivalent)	3 Nr
Envelopes (all sizes)	3 Doz.
Batteries for flashlights	3 Sets
Colour and Black ink cartridges for the A3 printer	1 Set
Black ink cartridge/ toner for the A3 printer	3 Nr

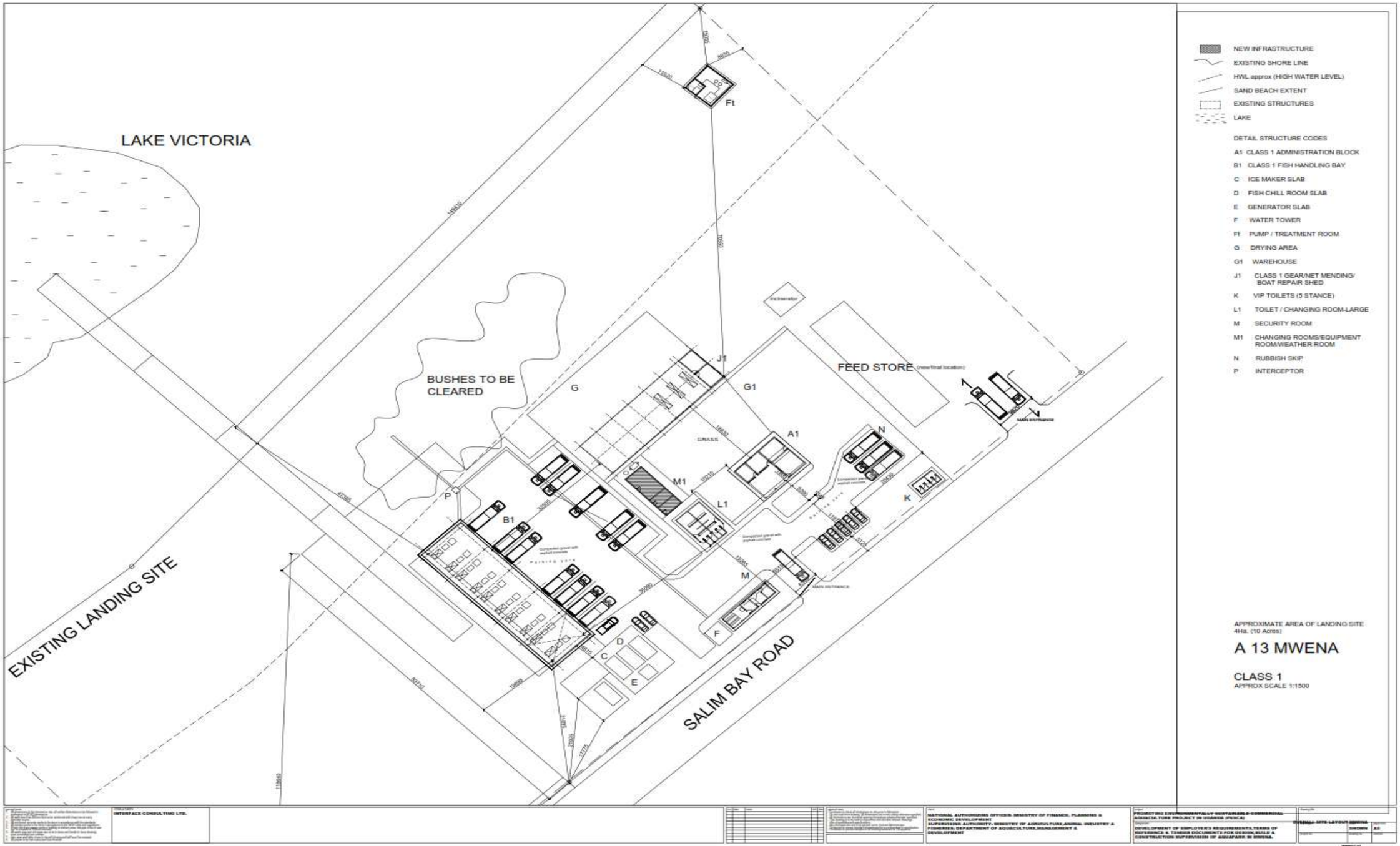
The Resident Engineer's offices shall be regularly and properly cleaned to the satisfaction of the Engineer. A messenger, and tea boy / office cleaner shall be provided by the Contractor exclusively for the Resident Engineer's offices. Also, Security Guards shall be provided for day and night security at these offices. The offices, furniture and equipment shall be insured against fire, theft and natural calamity.

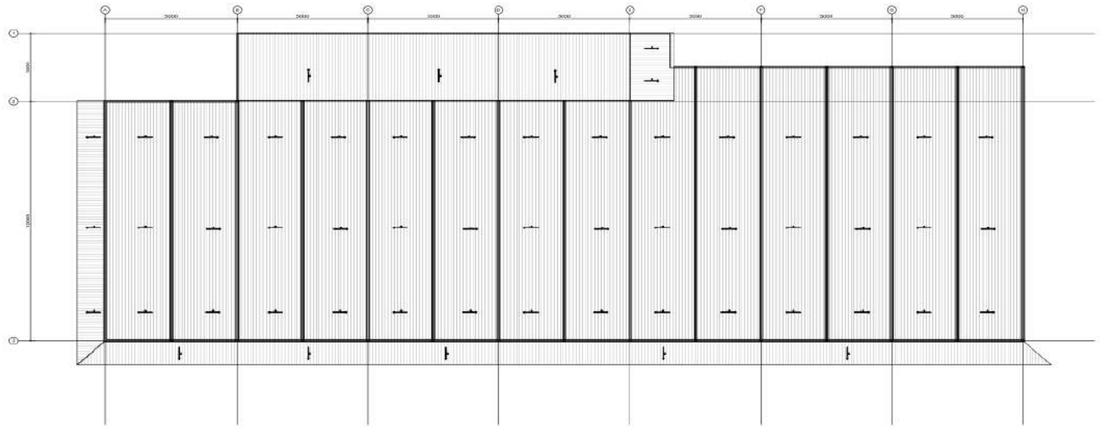
The Contractor shall provide a Secretary who can speak English and is conversant in the use of above-mentioned software for the duration of the Contract. Stationery required for **one month** as follows:

Stationery	
Photocopy paper A4	2 Reams
A3 paper	0.5 Ream
Biro pens blue/black	0.5 Doz.
Box files	4 Nr
Spring Files	2 Nr
Document Wallets	3 Nr
Cello tape (medium)	1 Nr

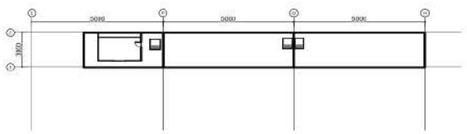
4 DRAWINGS

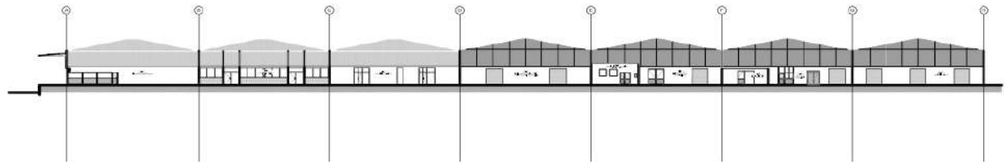
4.1 Site Layout
4.2 Feedstore, training room and offices
4.3 Equipment, changing and weather rooms
4.4 Surface water supply intake works
4.4.1 Anchor block details
4.5 Hatchery layout
4.5.1 Hatchery building plan
4.6 Circular cage details
4.7 Square cage details


LAKE VICTORIA
EXISTING LANDING SITE
SALIM BAY ROAD
BUSHES TO BE CLEARED
FEED STORE
Ft
J1
G
G1
A1
N
M1
L1
K
P
B1
M
F
D
C
E
NEW INFRASTRUCTURE
EXISTING SHORE LINE
HWL approx (HIGH WATER LEVEL)
SAND BEACH EXTENT
EXISTING STRUCTURES
LAKE
DETAIL STRUCTURE CODES
A1 CLASS 1 ADMINISTRATION BLOCK
B1 CLASS 1 FISH HANDLING BAY
C ICE MAKER SLAB
D FISH CHILL ROOM SLAB
E GENERATOR SLAB
F WATER TOWER
FI PUMP / TREATMENT ROOM
G DRYING AREA
G1 WAREHOUSE
J1 CLASS 1 GEAR/NET MENDING/ BOAT REPAIR SHED
K VIP TOILETS (5 STANCE)
L1 TOILET / CHANGING ROOM-LARGE
M SECURITY ROOM
M1 CHANGING ROOMS/EQUIPMENT ROOM/WEATHER ROOM
N RUBBISH SKIP
P INTERCEPTOR
APPROXIMATE AREA OF LANDING SITE
4Ha. (10 Acres)
A 13 MWENA
CLASS 1
APPROX SCALE 1:1500
INTERFACE CONSULTING LTD.

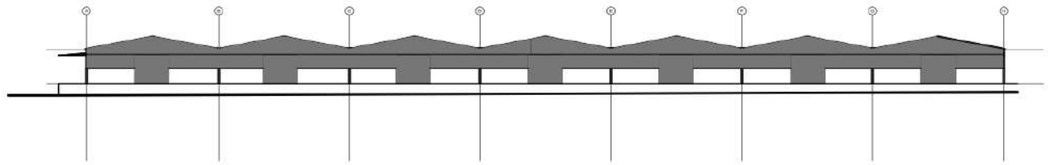


1 Roof Plan
Scale 1:250

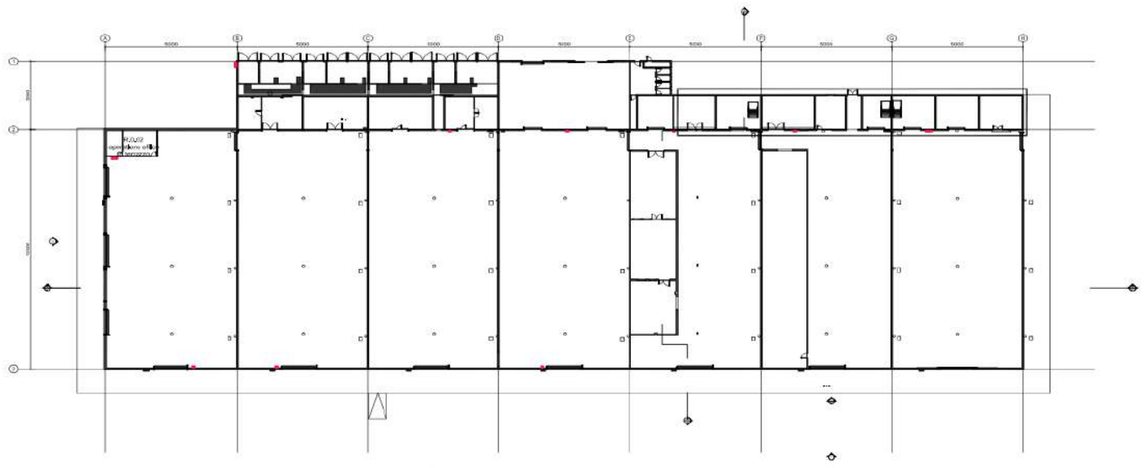




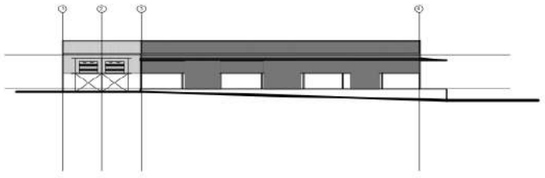
3 Section A-A
Scale 1:250



4 Elevation 01
Scale 1:250

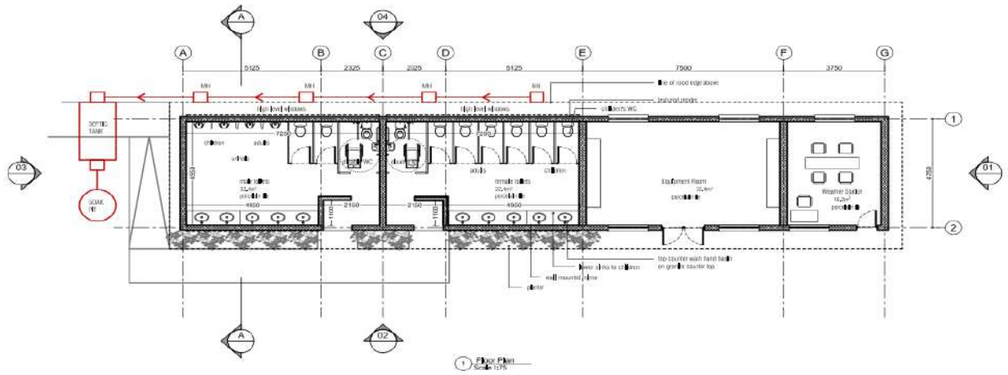


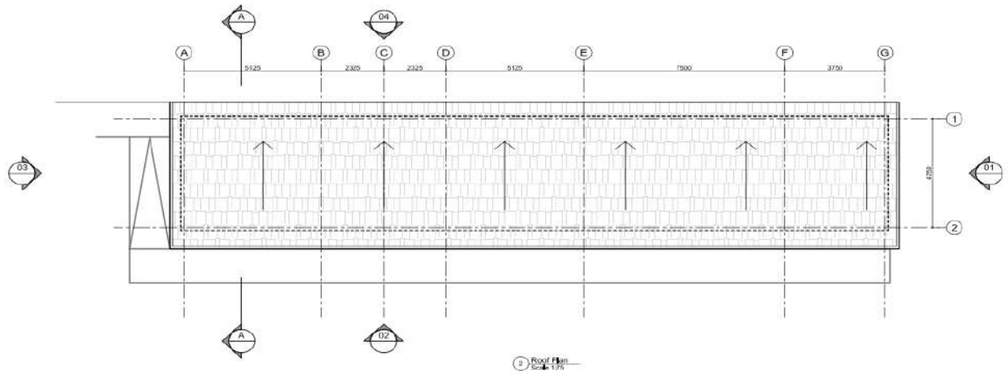
2 Ground Floor plan & Mezzanine
Scale 1:250



5 Elevation 02
Scale 1:250

	INTERFACE CONSULTING LTD.			NATIONAL AUTHORIZING OFFICER: MINISTRY OF FINANCE, PLANNING & ECONOMIC DEVELOPMENT SUPERVISING AUTHORITY: MINISTRY OF AGRICULTURE,ANIMAL INDUSTRY & FISHERIES/ DEPARTMENT OF AQUACULTURE,MANAGEMENT & DEVELOPMENT	PROMOTING ENVIRONMENTALLY SUSTAINABLE COMMERCIAL AQUACULTURE PROJECT IN UGANDA (PESCA) DEVELOPMENT OF ERPLOTER'S REQUIREMENTS,TERMS OF REFERENCE & TENDER DOCUMENTS FOR DESIGN,BUILD & CONSTRUCTION SUPERVISION OF AQUAPARK IN MWENA,	WAREHOUSE DETAILS SHOWN A0 01-01


SEPTIC TANK
SOAK PIT
Equipment Room
Weather Station
female toilets
male toilets
Baffle wall
WORKING LEVEL
Falls to soakpit
GL support bracket anchored into conc. brickwork
Solid conc. blockwork/reinforced hollow blockwork rendered internally / externally with cement sand plaster (1:4)
Solid Conc. brickwork rendered both sides with cement sand plaster
To be same diameter as outlet pipes
Walling in Accordance With Tank size & Capacity as per Table 1
Rendering (1:4) Cement sand plaster
126mm thick conc. base (1:2:4) where depth to invert level less than 1500mm
Cast-iron medium duty cover & frame for clear 600x450 opening & bedded into cement mortar
Determined by Ground slope and Drain length
Cover slab to project 100mm minimun above ground level ingress of storm water
MH 1
MH 2
MH 3
MH 4
Longitudinal Section Through Septic tank


Cover slab to project 100mm minimun above ground level ingress of storm water
Walling according to Table 2
To soakpit
Lean mix concrete benching with cement rendering
Cross Section Through Manhole Bed

RC slab (1:2:4)
Working level
GL Support Drain
Concrete Foundation Base (1:3:6) Mix 20mm aggregate, to eb of specified thickness (150mm min)
Cross Section Through Septic tank

Elevation 02
Elevation 03
Elevation 01
Elevation 04
Section A
Floor Plan
Roof Plan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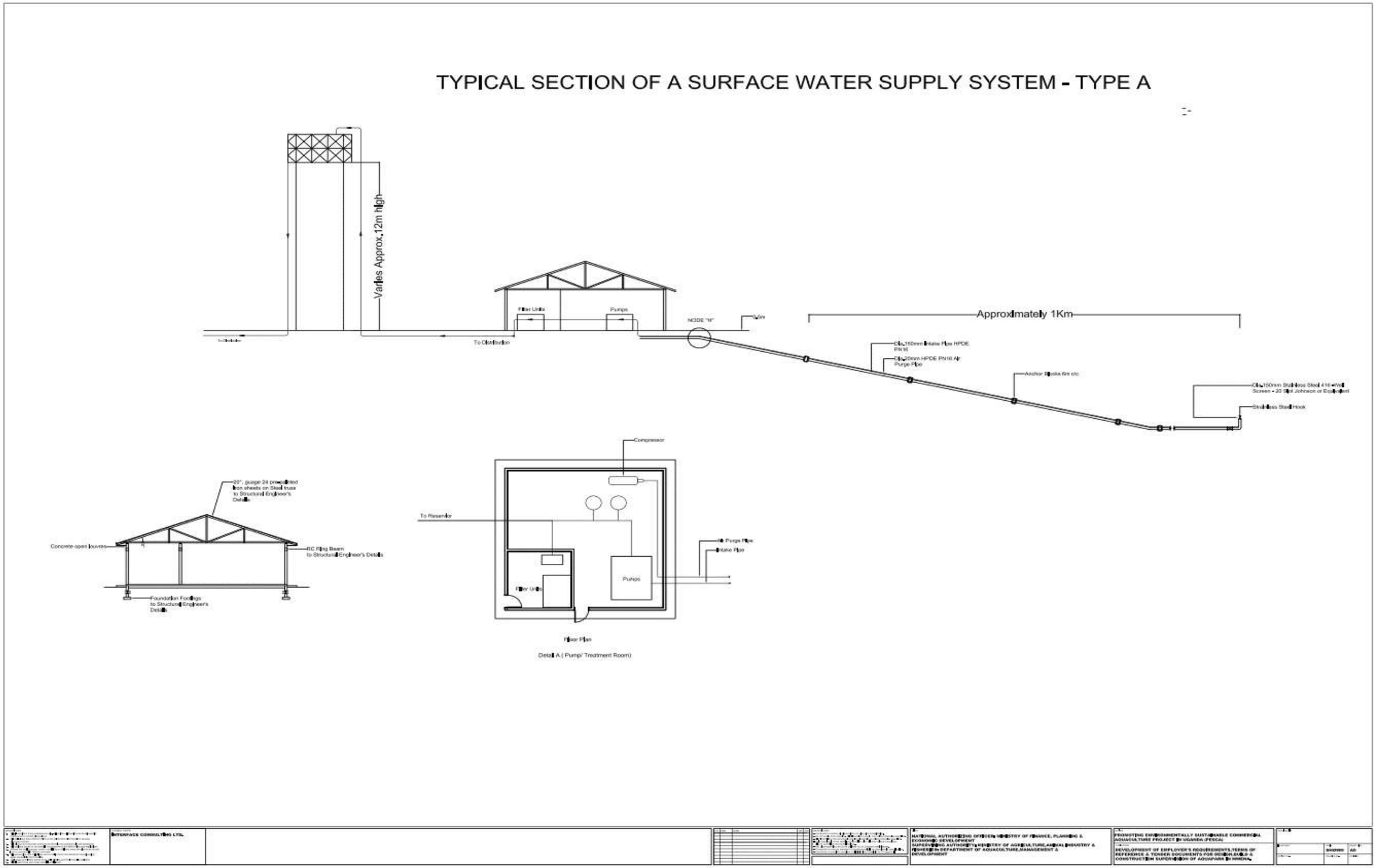
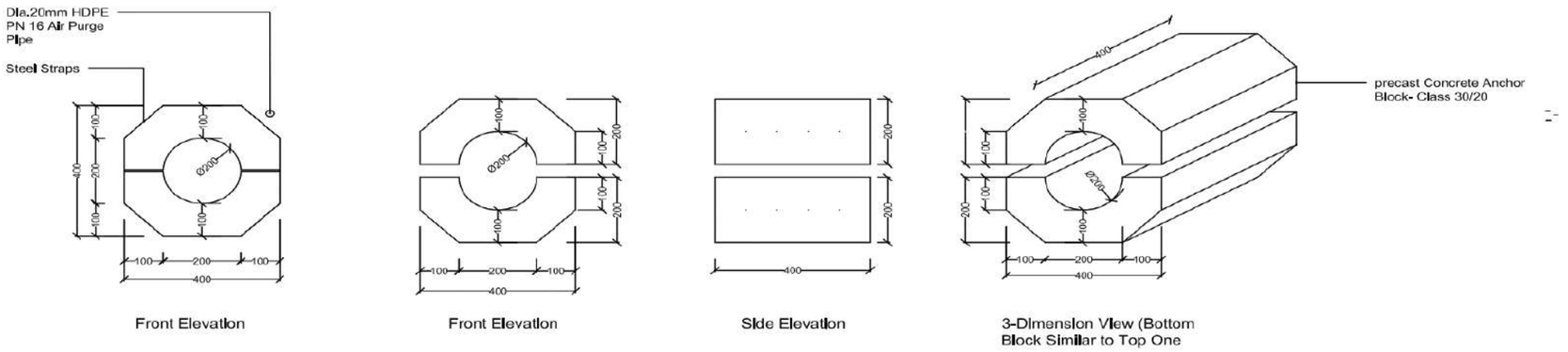
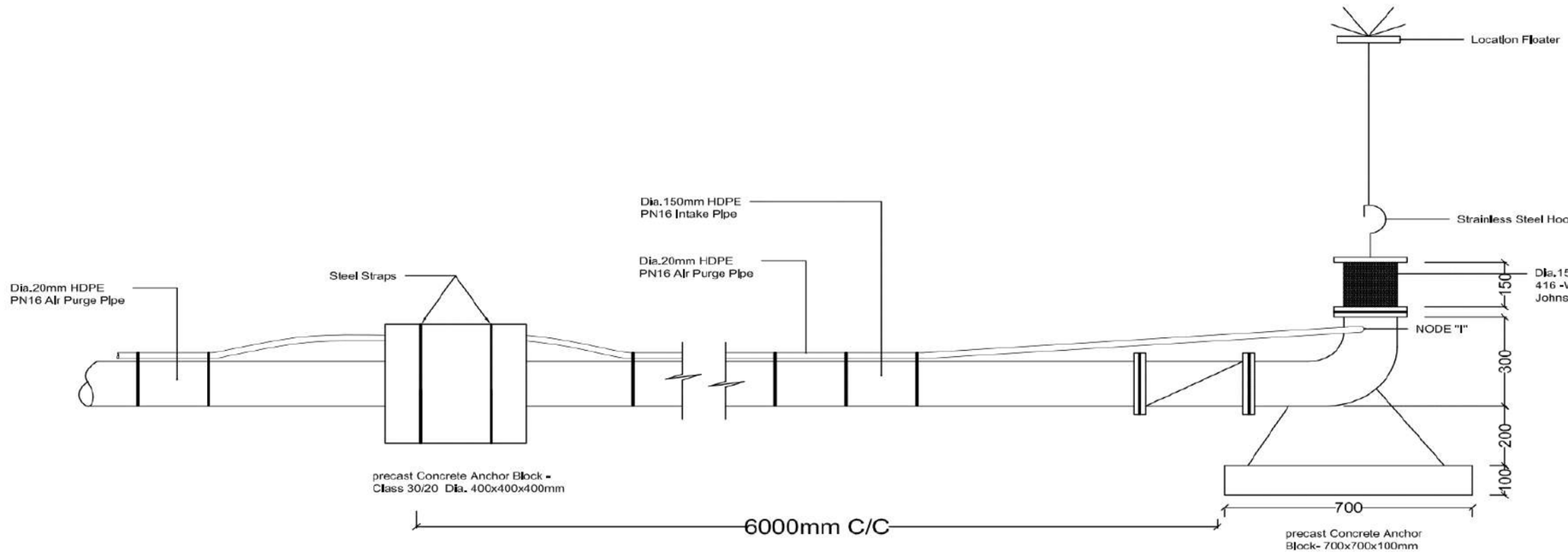
SUPERVISING AUTHORITY: MINISTRY OF AGRICULTURE,ANIMAL INDUSTRY & FISHERIES
IMPLEMENTING DEPARTMENT OF AQUACULTURE,MANAGEMENT & DEVELOPMENT
PROMOTING ENVIRONMENTALLY SUSTAINABLE COMMERCIAL AQUACULTURE PROJECT IN UGANDA (PESCA)
DEVELOPMENT OF EMPLOYER'S REQUIREMENTS,TERMS OF REFERENCE & TENDER DOCUMENTS FOR DESIGN,BUILD & CONSTRUCTION SUPERVISION OF AQUAPARK IN MWENA.
CHANGING ROOM, EQUIPMENT ROOM & WEATHER ROOM
SHOWN
A0
M1-01

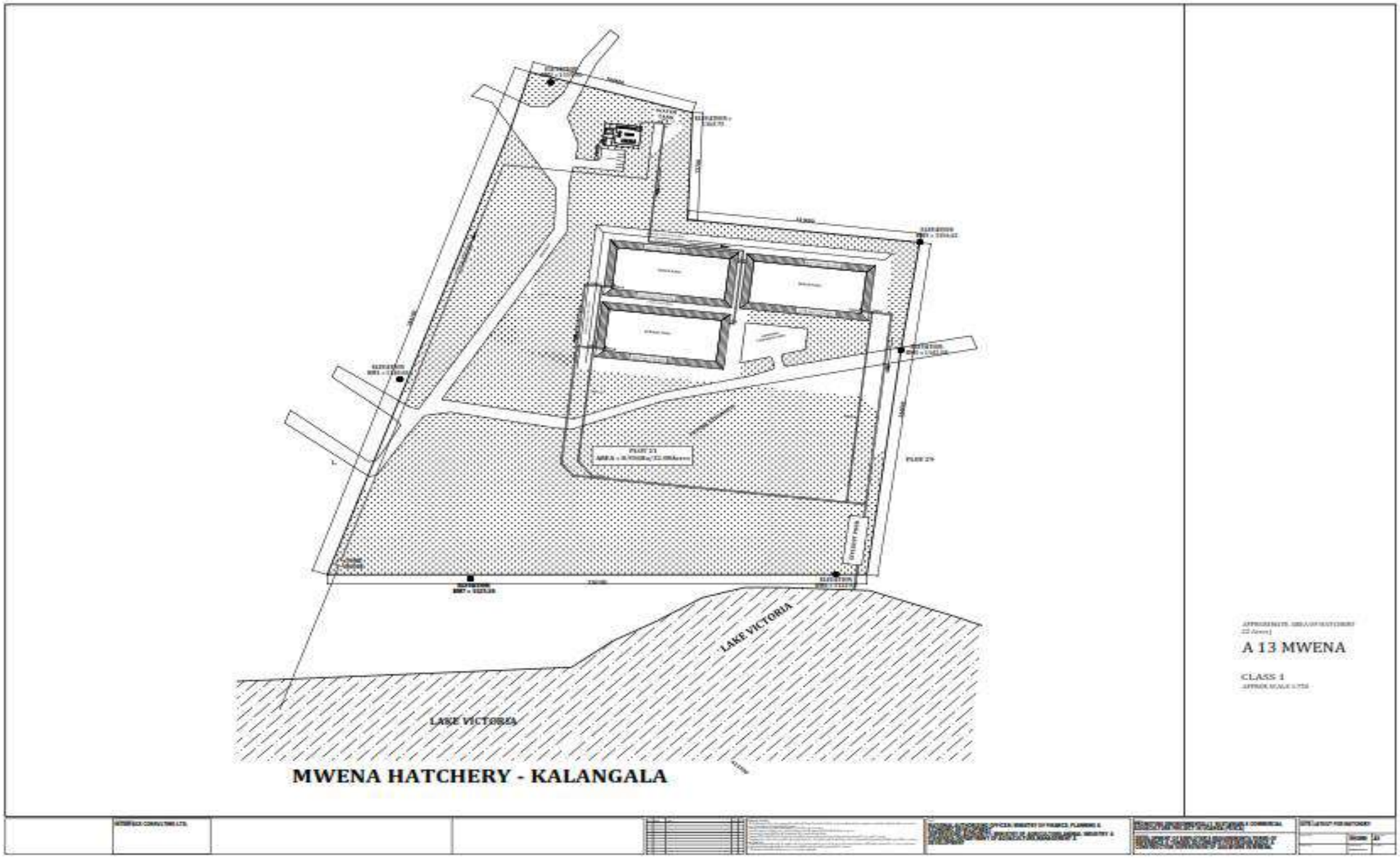

TYPICAL SECTION OF A SURFACE WATER SUPPLY SYSTEM - TYPE A
Varies Approx.12m high
Approximately 1Km
Compressor
To Reservior
Air Purge Pipe
Intake Pipe
Pumps
Filter Units
Floor Plan
Detail A (Pump/ Treatment Room)
Concrete open louvres
RC Ring Beam to Structural Engineer's Details
Foundation Footings to Structural Engineer's Details

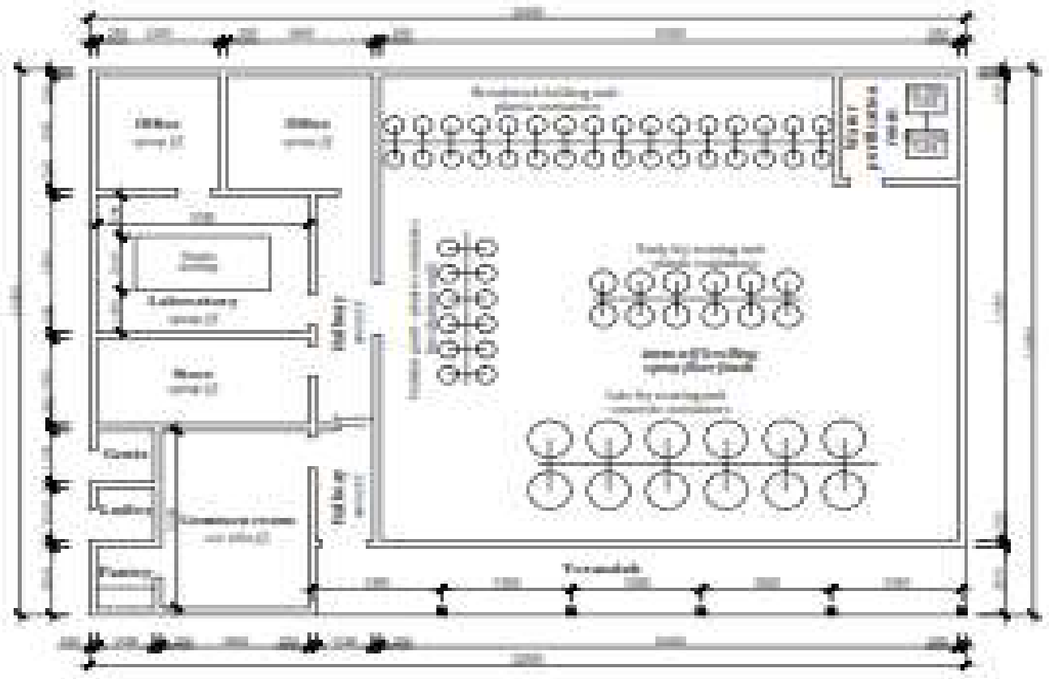


Anchor Block For 150mm Diam. Suction Line
Spacing = 6m C/C



INTAKE POINT - TYPE A


LAKE VICTORIA
LAKE VICTORIA
A 13 MWENA
CLASS 1
MWENA HATCHERY - KALANGALA



RATCHERY BUILDING - MWENA KALANGALA

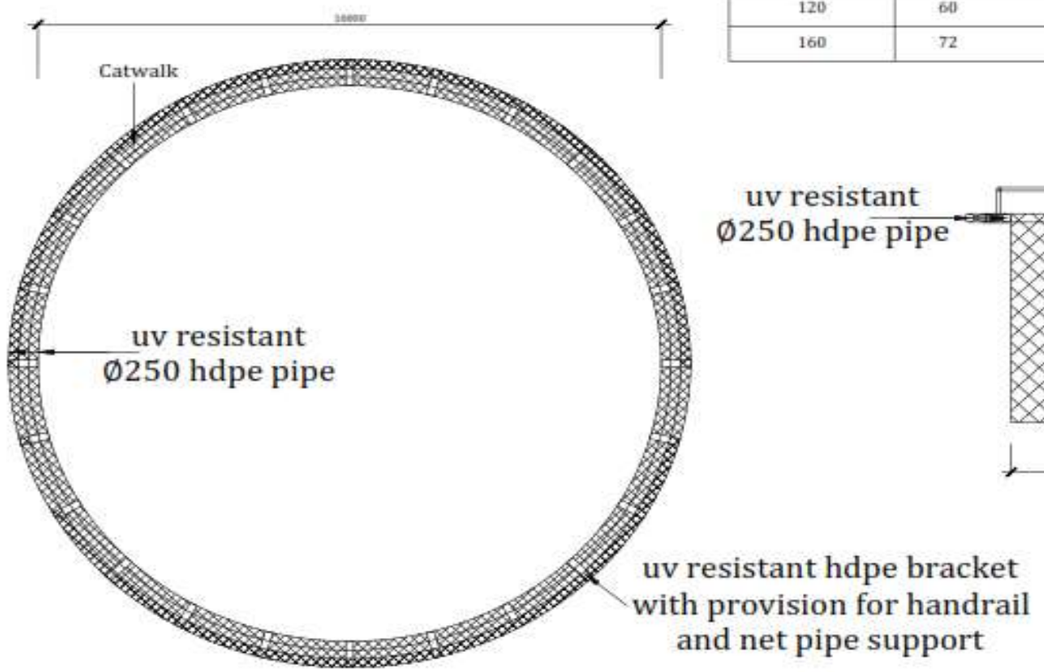
A 1.5 MWENA

CLASS 1

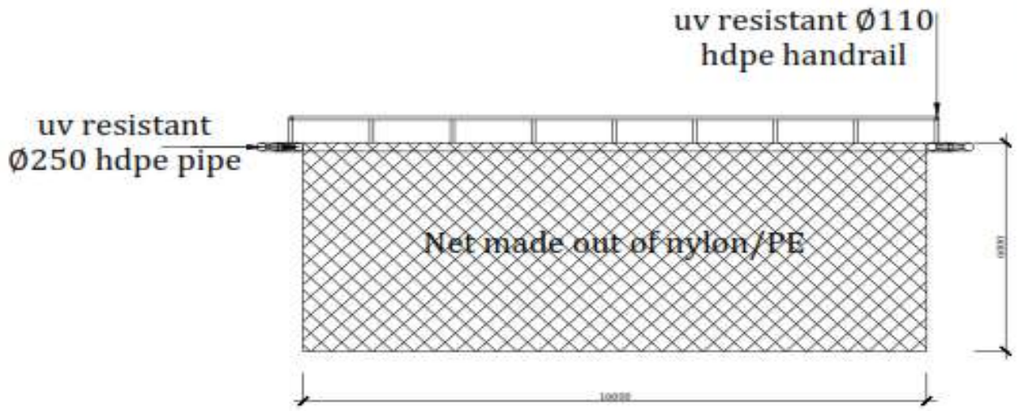
High quality HDPE fish farming net cage (PE 100 PIPES)					
Circumference	30m	40m	50m	80m	120m
Floating pipe	Φ200mm	Φ250mm	Φ250mm	Φ315mm	Φ315mm
Bracket	L200	L250	L250	L315	L315
Handrail pipe	Φ110mm	Φ110mm	Φ110mm	Φ110mm	Φ110mm
Sinker pipe	Φ110mm	Φ110mm	Φ125mm	Φ160mm	Φ200mm
Frame system: HDPE tubular products complete with connections, the frame to have the ability to resist big waves, all pipes go through anti-UV and antioxidant process, service life at least 15 years.					

BRACKETS CONFIGURATIONS	
Circumference (m)	Brackets (No.)
32	12
40	16
50	24
60	24
70	32
80	36
90	48
120	60
160	72

MAIN PIE (PE 100 PIPES)		
Pipe dia.	PN	Pipe thickness
200	10	11.9
250	16	14.8
250	16	22.7
315	16	28.4
400	16	36.3
HANDRAIL (PE 100 PIPES)		
110	10	6.6
110	16	10.0



TYPICAL PLAN OF CIRCULAR CAGE - MWENA KALANGALA

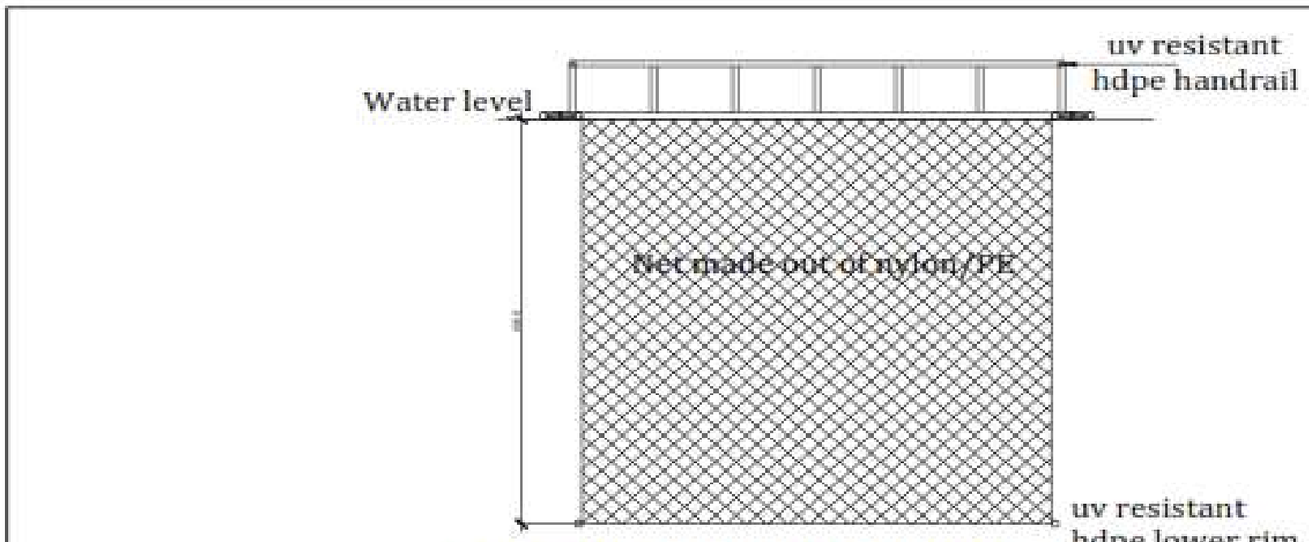


APPROXIMATE AREA OF CAGE (201SQM)

A 13 MWENA

CLASS 1

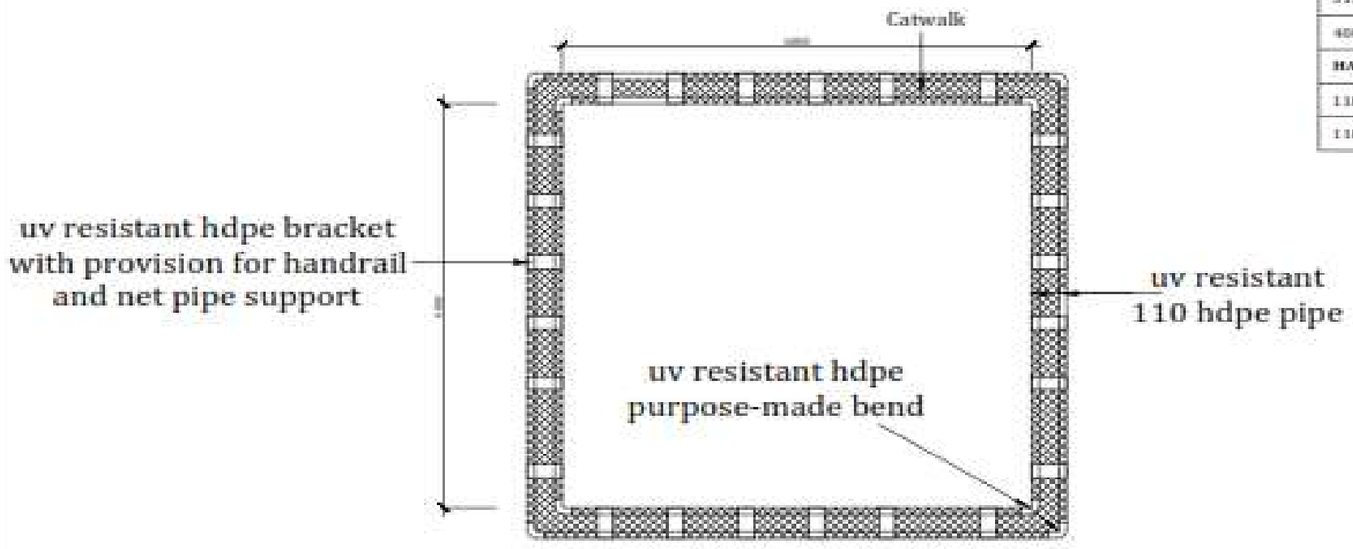
APPROX SCALE 1:50



SECTION THROUGH THE CAGE - MWENA KALANGALA

BRACKETS CONFIGURATIONS	
Perimeter (m)	Brackets (No.)
32	12
40	16
50	24
60	24
70	32
80	36
90	48
120	60
160	72

MAIN PIE (PE 100 PIPES)		
Pipe dia.	PN	Pipe thickness
200	10	11.9
250	10	14.8
250	16	22.7
315	16	28.6
400	16	36.3
HANDRAIL (PE 100 PIPES)		
110	10	6.6
110	16	10.0



TYPICAL PLAN OF SQUARE CAGE - MWENA KALANGALA

A 13 MWENA

CLASS 1

Urban Road

ROAD SECTION CONDITION ASSESSMENT FORM

Form 1

District/City Code: 101 | District/City Name: KALANGALA | MC/TC/S: C | T01 | MC/TC/SC: KALANGALA TC

Road Code: 101T010001 | Road Name: Mwena road | Road Class: 4 | Start Village: Mwena | End Village: Mwena

Surveyed by: Interface | Survey Date: 27/07/9 | Survey Vehicle: 4WD | Weather: Sunny | Road Condition: Dry (Dry or Wet)

Road Length: 6.00 | Garmin Raw Data File: 42072.47083 | Track Name: TR_101T010 001_MWEE | Survey Direction: Forward

Road Sectiton No.	Road Section Chainage (km)		Road Section Length	Road Surface Type	Drainage Condition Factor		Shoulder Condition Factor		Roughness Surface Conditon Factor	Carriageway Width	Shoulder Width	Waypoint (Start point)			Waypoint (End point)			Average Speed	Remarks
	start	end	(km)		left	right	left	right		(m)	(m)	No.	Latitude	Longtitude	No.	Latitude	Longtitude	km/hrs	
(i)	(ii)	(iii)	(iv)	(v)	(vi)	(vii)	(viii)	(ix)	(x)	(xi)	(xii)	(xiii)	(xiv)	(xv)	(xiii)	(xiv)	(xv)	(xxvi)	(xvii)
	Record Odometer Reading i n GPS (Start)		Calculated as (iii) - (ii)	Stop and perform Check	Stop and perform Visual Check		Stop and perform Visual Check		Based on Average Speed (xxiv)	Stop and perform Measurement		Record From GPS			Record From GPS			Record from GPS the Speed - Moving Avg.	
1	0.00	3.000	3.000	Gravel	Poor	Poor	Poor	Fair	2	4.0	1	11	S0.32151	E32.29202	21	S0.32623	E32.30971	17.4	End of road at Lake Victoria. Road requires maintenance

(v) Road Surface Type
1.Earth: Not graveled in last 5 years
2.Gravel: Graveled in last 5 years

(vi) & (vii) Drainage Condition Factor
1-Good/2-Fair/3-Poor/4-Bad

(viii) & (ix) Shoulder Condition Factor
1-Good/2-Fair/3-Poor/4-Bad

(x) Road Surface Condition Factor
1-Good/2-Fair/3-Poor/4-Bad


NEW INFRASTRUCTURE
EXISTING SHORE LINE
HWL approx (HIGH WATER LEVEL)
SAND BEACH EXTENT
EXISTING STRUCTURES
LAKE
DETAIL STRUCTURE CODES
A1 CLASS 1 ADMINISTRATION BLOCK
B1 CLASS 1 FISH HANDLING BAY
C ICE MAKER SLAB
D FISH CHILL ROOM SLAB
E GENERATOR SLAB
F WATER TOWER
FI PUMP / TREATMENT ROOM
G DRYING AREA
G1 WAREHOUSE
J1 CLASS 1 GEAR/NET MENDING/ BOAT REPAIR SHED
K VIP TOILETS (5 STANCE)
L1 TOILET / CHANGING ROOM-LARGE
M SECURITY ROOM
M1 CHANGING ROOMS/EQUIPMENT ROOM/WEATHER ROOM
N RUBBISH SKIP
P INTERCEPTOR
LAKE VICTORIA
MATURE TREES
BUSHES TO BE CLEARED
EXISTING LANDING SITE
VILLAGE
BUGALA ISLAND
base scenario
LAKE VICTORIA
MATURE TREES
BUSHES TO BE CLEARED
FEED STORE
EXISTING LANDING SITE
SALIM BAY ROAD
BUGALA ISLAND
community engagment scenario
APPROXIMATE AREA OF LANDING SITE 4Ha. (10 Acres)
A 13 MWENA
CLASS 1
APPROX SCALE 1:1500
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NATIONAL AUTHORIZING OFFICER: MINISTRY OF FINANCE, PLANNING & ECONOMIC DEVELOPMENT
SUPERVISING AUTHORITY: MINISTRY OF AGRICULTURE,ANIMAL INDUSTRY & FISHERIES; DEPARTMENT OF AQUACULTURE,MANAGEMENT & DEVELOPMENT
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OVERALL SITE LAYOUT MWENA
SHOWN
A0