Design & Construction of 39 Piped Water Supply System in Tete, Inhambane and Sofala

1. Background and Context

Under the UNICEF and the Government of Mozambique partnership which aim to contribute to the improvement of access to drinking water and adequate sanitation, the implementation of the UNICEF water supply, sanitation and hygiene program covering is in progress in various provinces.

The challenge of providing water supply infrastructures have faced many technical constraints in the country, due partly to its hydrogeological complexity – sometimes characterized by the occurrence of poor aquifer at great depths and brackish – and rapid population growth making the efficiency of handpumps one of the major challenge to answer each time a large number of users, the increase of demand.

Thus, in order to find simple and viable technological options for water supply in villages where hand pump do not respond to water needs due to limited abstraction flow or the water table is very deep, UNICEF, in coordination with the Inhambane, Tete, and Sofala DPOPHRH's is undertaking the following interventions included in this Contract.

2. Justification

This intervention aims to improve the level of water supply service aims to support on the one hand and drought mitigation actions by other maximize the exploitation of existing positive boreholes in order to respond to an increasing demand for sustainable, resilient access to water.

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The Mini piped water supply systems to build will be essentially made up of:

- Equipping existing boreholes with submersible pumps driven by solar panels or connected to public electricity network as appropriate;
- Installation of a main pipe connected to new elevated reservoir located near to the borehole;
- Installation of a small distribution network with tap stands (DNAAS Design - maximum 3 tap stands).

3. Purpose and Objective

The main objective of this Contract is the improvement of water supply services in targeted communities, through the transformation of boreholes equipped with hand pumps into mini piped water supply systems driven by solar panels or by public network power as appropriate. This Contract is aimed to increase the availability of water in up to 39 communities in Tete (11), Inhambane (7) and Sofala (21) provinces.

4. Methodology and Technical Approach

Works must be executed in accordance with approved Proposal in response to UNICEF's LRPS-2016-9127396 and as per the instructions to be provided by the Engineering Consulting Firm in charge of the supervision of design and execution of works.

The work will be performed in a phased manner and shall include 3 stages:

Phase A: Realization of a Borehole Flow / Yield Test, including water quality test according to the MISAU standard. Evaluation of the productivity of the borehole and design of the pumping system components. Results will be submitted for approval by the designated Engineering Consulting Firm.

Phase B: Finalization of design for the project, including any proposed changes to the project based on the pump test, and submit for approval by the Engineering Consulting Firm.

Phase C: Construction of water supply systems.

Note 1: All activities, reports and deliverables to be conducted and produced by the Contractor will be

supervised by the Engineering Consulting Firm who is contracted for the supervision of design and construction of the piped water supply systems.

Note 2: The number of systems to be included under phase B and C will be defined based on the results of tests carried out under phase A and as per approval by the Engineering Consulting Firm.

5. Activities and Tasks

PHASE A: PUMPING TEST FOR THE INTAKE BOREHOLE

In the working area, the occurrence of groundwater is related with Quaternary deposits along the main rivers and water lines closely linked fractures and zones of colluvium related to mountain areas and escarpments. The geological complexity and productivity of aquifers vary from medium to very weak. In potentially productive areas (sedimentary environments), the flow rates vary between 3-10 m^3/h.

For the proposed boreholes, the pumping test must be performed with a submersible pump with a minimum capacity of 5 m^3/hour considering the existing boreholes dates.

The pumping test must follow three pumping steps (3 levels), where each has a fixed flow (Level 1: 2 m^3/h; Level 2: 3 m^3/h; Level 3: 5 m^3/h). Pumping at each level must have a duration of 60 minutes and dynamic water level should be measured at 10 minute intervals and presented in the test sheet. The change from one test step to the other can be made as soon as to the flow is stabilized for at least 3 consecutive readings, even if before the 60 minutes.

The pumping test for the following step can only start after the dynamic level of the previous step stabilized. During the pumping test relegation and recovery, all water levels must be measured using a meter of electrical contact that has at least 50 m for Tete and 150 m for Inhambane of tape length. There should be at least 2 meters on site in perfect condition during the test and further 2 watches for timing. The contractor must perform pumping tests in the presence of representatives from the Engineering Consulting Firm.

After the completion of the last pumping level and the pumping has stopped, the ground water table recovery must be observed and recorded every 10 minutes until the original static water level is reached (or within 5% of original level). The test data must be presented in flow sheets for the appropriate effect and for analysis.

PHASE B: EVALUATION PUMPING TEST RESULTS AND PREPARATION OF THE EXECUTIVE PROJECT OF THE MINI PIPED WATER SUPPLY SYSTEMS

Depending on the conditions at field level, the water supply systems will be powered either by solar photovoltaic panels or by connection to the public electricity network. The details on the potential power source per system is included in Annex 1 at the end of this document.

a) For communities to be powered by photovoltaic arrays and the project design should consider and include the following elements:

- 5 Hours of pumping per day (estimated mean peak sun hours)
- Daily production capacity of the system must respond to total community demand as per table
- Configuration of solar panels modules (capacity, wiring, installation, security, fencing) with all panels have minimum guarantee of at least 20 years
- Control Panel (including auto-shut off system)
- Electric Cables (minimum gauge must be designed for maximum of 3% loss)
- All electrical cables should be buried to a depth > 50 cm
- Pipes:
  - the pump Column – main raising pipe (HDPE, NP9)
  - Elevation from the top of the borehole to the tank including the output of the tank (FG)
  - Distribution, from the deposit to the stand tap (HDPE, buried)
- Tank height is 6m to base of tank
- Average Distance between the borehole and the tanks (~230 metres)
- Average total head should be estimated according to borehole dates in the table (between submersible pump and top of tank).
- Specifications of tanks (material type) and taps (Talbot taps required)
- Design of Stand tap (type DNAAS design with 2 tap) with drainage system

- Consider 300 person/tap
- Include a water trough for animals
- Include a over flow pipe to the top of the tanks for the collection and channelling of the water to the trough for animals in case of "over flow" of the tank

b) ***For communities where systems will be driven by the public electricity network power and the project design should consider and include the following elements:***

- Daily production capacity of the system to respond the total demand per day
- Extension of the electricity network to the location of the borehole (maximum 100 m)
- Control Panel (including auto-shutoff system for pump and auto-shutoff for tank (float valve connected)
- The electrical cable should be buried to a depth > 50 cm Pipes:
  - the pump Column – main raising pipe (HDPE, NP9)
  - Elevation from the top of the borehole to the tank including the output of the tank (FG)
  - Distribution, from the tank to the stand tap (HDPE, buried)
- Tank height is 6m to base of tank
- Average Distance between the borehole and the tanks (~230 metres)
- Average total head should be estimated to be 60m (between submersible pump and top of tank).
- Specifications of tanks (material type) and taps (Talbot taps required)
- Design of Stand tap (type DNAAS design with 2 tap) with drainage system
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Note: The drawings of executive project of the hydraulics components of the systems, will be presented and discussed with the Engineering Consulting Firm. Results of Phase A and Phase B require approval from the Engineering Consulting Firm before contractor proceeds to Phase C.

PHASE C: EXECUTION OF THE CONSTRUCTION WORKS OF THE MINI PIPED WATER SUPPLY SYSTEMS

Upon receipt of approval, the contractor will perform the construction of systems, in the light of the approved designs. Works will include:

- Supply/installation of the components in the intake system (borehole, power system);
- Supply/installation of piping and distribution components;
- Training of the Operators of the system.

All construction works will be coordinated with the representatives of the Engineering Consulting Firm and in close consultation with District and Province officials.

6. Deliverables and Timeframe

According to the phases of implementation of the contract, design and implementation of rehabilitation works of the systems, the sequence of activities and expected results:

PHASE	Activities	Deliverables
A	✓ Pumping Test of 39 boreholes in proposed communities ✓ Data Analysis of productivity the boreholes	Report on the productivity of boreholes, approved by the Engineering Consulting Firm
B	✓ Executive Project of hydraulic component of up to 39 Mini-systems; ✓ Presentation of final design for the construction works	Executive project and designs for each system approved by the Engineering Consulting Firm
C	✓ Mobilization of equipment and materials for the district ✓ Implementation of Works.	Operational water supply systems, certified by the Engineering Consulting Firm

7. Management, Organization and Schedule

UNICEF will engage with, through a separate Contract, Engineering Consulting Firm(s) in charge of tthe monitoring, supervision and management of the works included. UNICEF will communicate to the

Contractor the name and contact details of the Engineering Consulting Firm(s) upon signing of this Contract. The Engineering Consulting Firm(s) will interact and work closely with the Contractor on a regular basis and will be responsible for the day-to-day monitoring and supervision of the works in terms of progress, quality, and compliance with all contractual requirements. Certification of payment claims by the Contractor will also be done by the Engineering Consulting Firm(s).

The contract will be issued by UNICEF Mozambique, and a dedicated focal point within UNICEF WASH Section will be appointed for all communication and coordination of implementation process.

The contractor will be responsible for all logistical arrangements associated with the execution of the contract. UNICEF will not provide assistance in the areas of visas, banking/cash services, or office space/equipment (including computers, photocopiers).

The duration of the construction period is indicated in the table below. The contractor is required to allocate sufficient logistic and human resources to complete construction works in this period.

Province	**# systems**	**Estimated number of days/phase**		
		PHASE A: Testing	**PHASE B: Design**	**PHASE C: Construction**
Inhambane	7	10	20	60
Tete	11	10	20	60
Sofala	21	45	20	90

NOTE 1: The number of days are estimates considering the geographical dispersion of the communities in each province. A completion workplan and milestones schedule are to be provided by the Contractor upon signing of the Contract. These are to be reviewed and approved by the Engineering Consulting Firm and will be attached as an Annex to this Contract.

A defects liability period of one year will be included in the contract. This period will start after completion of works and commissioning / reception of the same. During the defects liability period Contractor(s) may be called to attend faults / defects related to the fabrication and / or installation of equipment or materials in the water supply system.

8. Budget and Remuneration

The contractor will be paid only upon completion of each assignment phase and upon presentation of invoice together with proof of services delivery and supporting documents certified by the Engineering Consulting Firm.

The contract will hold a 5% retention to be paid one year after the completion of works (i.e. defects liability period). Payment of the retention will be made upon satisfactory certification of the functionality all water supply systems. Faults on faults during the defects liability period and satisfactory response by the Contractor.

The total budget per phase is as per following (values in Meticals, including VAT)

	Tete	**Inhambane**	**Sofala**	**TOTAL**
Phase A (including P&G)	2,347,488.00	1,493,856.00	9,283,248.00	**13,124,592.00**
Phase B	978,120.00	622,440.00	1,867,320.00	**3,467,880.00**
Phase C	29,347,423.56	14,243,383.44	48,281,337.00	**91,872,144.00**
TOTAL	**32,673,031.56**	**16,359,679.44**	**59,431,905.00**	**108,464,616.00**

Payments will be done after the satisfactory completion of activities and works certified by the Engineering Consulting Firm. The maximum amount to be paid per phase is as per stated above.

9. Contractors staff and equipment

According to the nature of the activities that include the design and implementation of the works, the contractor will have a team of professionals who understand specialties in Water supply systems.

Based on his technical proposals, the Contractor's team must include:

a) The Hydraulic Engineer/Civil as team leader that must have experience of at least 5 years in the design of piped water supply systems, in particular rehabilitation and extension studies.

b) Hydro-mechanical technician with at least 7 years' experience in work with electromechanical equipment for the water supply. The area of solar panels systems will give a large advantage.

c) A team work with proven experience in building piped water supply systems which could include:

- Plumbers
- Electrician
- Mason
- Assistants

Any changes on the team members must be approved by the Engineering Consulting Firm prior implementation by the Contractor.

d) Equipment

	Equipment type and characteristics (the bidding company must present the specifications of the equipment you will use, age and current condition)	**QTY required per province**
1	Generator (6.5 KVA, 400/230V e 50 Hz)	1
2	Submersible pump 10m3/h – 50 m ht with flow meter for borehole testing	1
3	Carrinha 4X4 de caixa aberta	1
4	Electric probe for the control the water levels and borehole depth	1
5	Chronometer	1
6	GPS (topographic)	1
7	Total Station (topography), or alternatively a GPS for topographic survey	1
8	Truck 5-7 ton	1
9	Concrete mixers with a minimum capacity of 50 liters	1
10	Concrete Vibrator	1
11	pneumatic Compactors	1
12	Device for bending iron rods	1
13	Soldering machine	1
14	Water tank (10 000 l)	1
15	Wheelbarrows (or other alternative facilities for the same purpose)	2
16	Conductivity meter	1

Annex 1: Preliminary information on targeted systems (based on existing data, to be validated / confirmed during phase A of this assignment)

1.1. Tete Province

	Villages	Borehole (4")		Number of beneficiaries	Demand Pop (m3)	Storage requirement	Tap stands	Trough for animals	Potential Power Source
		Depth	Flow (hand pump measured)						
1	Carata	32.5	1.6	2,303	46	30	3	1	Solar Panels
2	Phacassa I	33.6	1.6	2,000	40	20	3	1	Electricity
3	Phacassa II	35.0	1.6	1,800	36	20	3	1	Electricity
4	Messaua I	34.0	1.7	3,535	71	30	3	1	Electricity
5	Messaua II	36.0	1.6	4,102	82	40	3	1	Electricity
6	Nhapende Juga	35.0	1.4	2,375	48	30	3	1	Solar Panels
7	Caconde Pata	*	*	2,564	51	30	3	1	Solar Panels
8	Nhandoa	32.0	1.5	4,402	88	40	3	1	Solar Panels
9	Cabvewe	*	1.7	2,140	43	20	3	1	Solar Panels
10	Nhaulire	*	*	978	20	10	2	1	Solar Panels
11	Luia Nhaguite	42	3.0	920	19	10	2	1	Solar Panels

*No available data

1.2. Inhambane Province

	Districts	Villages	Borehole (4")				Number of beneficiaries	Demand Pop (m3)	Tap stands	Required Volume (m3)	Trough for animals	Potential Power Source
			Depth	Yield	HL	DL						
1	Mabote	Tanguane Sede	39.0	4.0	29.1	29.3	1,115	22	2	10	1	Solar panels
2	Govuro	Chimedje	68.0	2.5	28.0	32.0	935	19	2	10	1	Solar panels
3	Inharrime	Chacane Povoação	100.0	3.0	46.0	49.1	1,590	32	3	20	1	Electricity
4	Homoine	Nhacuara	54.0	2.7	27.0	42.0	600	12	1	10	0	Solar panels
5	Massinga	Centro de Saude Chiunze	40.0	2.4	27.3	29.0	974	19	2	10	0	Solar panels
6	Zavala	EPC Belmiro O. Muianga	153.2	2.1	75.6	*	1,100	22	2	10	0	Solar panels
7		Centro de Saude Zandamela	126.0	3.8	46.6	47.8	1,670	33	3	20	0	Electricity

*No available data

1.3. Sofala Province

	Villages	Borehole (4")		Number of beneficiaries	Demand Pop (m3)	Storage requirement	Tap stands	Trough for animals	Potential Power Source
		Depth	Flow (hand pump measured)						
1	Nharongue/ Guara-Guara	44	2	1,450	29	15	3	tbc	Solar Panels
2	EP1 de Chindo/ Guara-guara	43	2	950	19	10	2	tbc	Solar Panels
3	Inhabirira/ Buzi sede	42	2	1,884	38	20	3	tbc	Solar Panels
4	Chivulivuli/Chemba-Sede	25	2	1,345	27	15	3	tbc	Solar Panels
5	Guengue/Chemba-Sede	51	5	368	7	5	1	tbc	Solar Panels
6	Bangue/Mulima-Sede	51	5	533	11	5	1	tbc	Solar Panels
7	Candieiro/Mulima-Sede	40	2	509	10	5	1	tbc	Solar Panels
8	Chindio/Chiramba-Sede	32	5	1,211	24	10	2	tbc	Solar Panels
9	Cudove/Chibabava-Sede	123	3	620	12	5	1	tbc	Solar Panels
10	Nhanendoa/Chibabava-Sede	54	4	456	9	5	1	tbc	Solar Panels
11	C.Saúde Mutindir/ Chibabava-Sede	63	3	1,050	21	10	2	tbc	Solar Panels
12	Magandafuta 3/ Savane-sede	45	2	1,470	29	15	3	tbc	Solar Panels
13	Xibuabuabua/ Savane-Sede	33	3	1,040	21	10	2	tbc	Solar Panels
14	Nhavingo/Savane-Sede	45	2	1,250	25	10	3	tbc	Solar Panels
15	Nhapiripiri 1 / Savane-Sede	60	2	1,800	36	20	3	tbc	Solar Panels
16	EPC Savane/ Savane-Sede	32	2	2,500	50	25	3	tbc	Solar Panels
17	Mutua/Mafambisse	45	2	1,470	29	15	3	tbc	Solar Panels
18	C. Saúde Tica	49	3	802	16	5	2	tbc	Solar Panels
19	Mapalanhanga/Nhamatanda-Sede	36	2	914	18	10	2	tbc	Solar Panels
20	Massanjoa/Nhamatanda-Sede	53	5	1,117	22	10	2	tbc	Solar Panels
21	Mussanga/Nhamatanda-Sede	61	5	1,272	25	10	3	tbc	Solar Panels